DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-5533

TO 31S3-2U-201

CODE RECORDER RD-60/U

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

JULY 1957

AGO 7223A—July

WARNING

EXTREMELY DANGEROUS VOLTAGES ARE
PRESENT IN THIS EQUIPMENT
SERIOUS INJURY OR DEATH
MAY RESULT IF
SAFETY PRECAUTIONS
ARE NOT OBSERVED.

Be careful not to contact high-voltage connections and other power connections when servicing this equipment. Before making test connections to or working on internal components, turn off the power and discharge all high-voltage capacitors by shorting them.

TECHNICAL MANUAL
No. 11–5533
TECHNICAL ORDER
No. 31S3–2U–201

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *18 July 1957*

CODE RECORDER RD–60/U

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* This manual supersedes TM 11–5533, 1 October 1951.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions on the operation, theory, and maintenance of Code Recorder RD–60/U.

b. Forward comments on this publication directly to Commanding Officer, United States Army Signal Publications Agency, Fort Monmouth, N. J.

2. Forms and Records

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468, Unsatisfactory Equipment Report, to Commanding Officer, United States Army Signal Equipment Support Agency, Fort Monmouth, New Jersey, as prescribed in AR 700–38.

b. Damaged or Improper Shipment. Fill out and forward DD Form 6, Report of Damaged or Improper Shipment, as prescribed in AR 700–58 (Army).

c. Preventive Maintenance Forms (figs. 8 and 9).

(1) Prepare DA Form 11–250, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Public Address, Recorder, Reproducer), in accordance with instructions on the back of the form.

(2) Prepare DA Form 11–251, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Public Address, Recorder, Reproducer), in accordance with instructions on the back of the form.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Purpose. Code Recorder RD–60/U (fig. 1) is a tape recorder of radio telegraph code signals.

b. Use. The RD–60/U is used in conjunction with code practice and training equipment such as Code Practice Equipments EE–94–F, EE–95–F, and EE–96–F, and Telegraphic Code Trainer AN/FGC–T1 (TM 11–2093). The RD–60/U is also used to record code signals received by communications receivers. The information recorded on tape may be used for sight reading or retransmission from a keyer.

4. Technical Characteristics

Operating voltage	115 or 230 volts, 50 to 60 cps.
Code speed	Up to 1,000 words per minute.
Input impedances (1,000 cps)	500 and 5,000 ohms.
Output impedance (MONITOR jack).	6 ohms.
Input signal frequency	500 to 5,000 cps.
Input signal voltage:	
500-ohm input	0.75 to 25 volts rms.
5,000-ohm input	1.5 to 50 volts rms.
Recording medium:	
Type	Paper tape.
Tape dimensions	⅜ in. wide, 800 ft long.
Tape speed and recording time:	
Low (max)	30 ft per minute (26 minutes).
High (max)	60 ft per minute (13 minutes).
Number of tubes	9.

5. Components

a. Main Components (fig. 1). The main components of Code Recorder RD–60/U are the recording mechanism and tape bin, a special

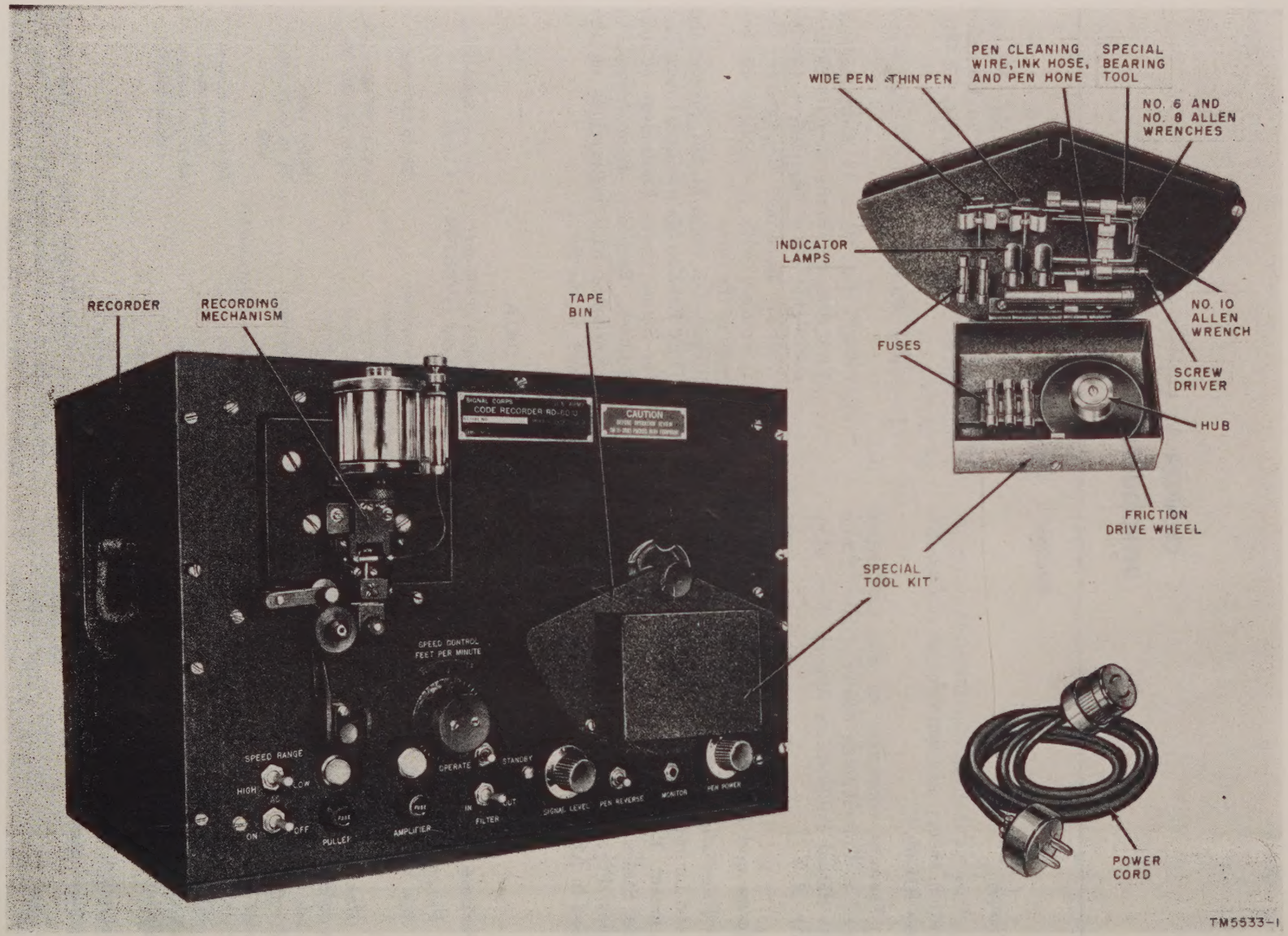


Figure 1. Code Recorder RD-60/U.

tool kit, and a power cord. The overall dimensions of the unit are 19 inches × 16 inches × 12¾ inches. The accessories and running spares are listed in *b* and *c* below.

b. Accessories.

Quantity	Item
7	Pen cleaning wires (varied diameters and thicknesses).
1	Ink hose, 4 inches long
1	Pen hone
2	Medicine droppers
1	Screw driver, 2⁷⁄₁₆ inches long
1	Special bearing tool
1	No. 6 Allen wrench
1	No. 8 Allen wrench
1	No. 10 Allen wrench
1	Wide pen
1	Thin pen
1	Hub (for tape roll)

c. Running Spares.

Quantity	Item
1	Friction drive wheel
1	Capacitor, 15uf
3	Fuses, 3-ampere
2	Fuses, 2-ampere
1	Electron tube 6SJ7Y
1	Electron tube 6x4W
1	Electron tube OA2
1	Electron tube 6SK7GTY
1	Electron tube 5V4G
1	Electron tube OD3
1	Electron tube 6L6WGB
1	Electron tube 6H6WGT
2	Indicator lamps, NE–51

Note. This list is for general information only. Refer to the appropriate publications for information pertaining to requisition of spare parts. Refer to paragraph 7 for a list of additional equipment required but not supplied as part of the recorder.

6. Description

(fig. 1)

The interior of the unit can be reached through a hinged lid on the top of the recorder. The recording mechanism and all the controls and switches necessary for operation are located on the front of the recorder. Spare parts and tools for servicing and replacing the inking pen are contained in a special tool kit attached to the tape bin. One inking pen is mounted on the recording mechanism, and two additional pens are located in the special tool kit. The power cord receptacle and input terminal board (fig. 4) are mounted on the rear of the chassis.

7. Additional Equipment Required

Equipments that are not supplied as part of Code Recorder RD–60/U but are required for its operation are listed in *a* through *d* below.

a. Oscillator VO–3–F and the amplifier of Keyer TG–34–B (TM 11–2093) or equivalent are required as a separate tone source to record manual practice transmissions by students.

b. A headset is required for monitoring of the signal being recorded.

c. Key J–38 (or equivalent) is required for direct operation.

d. Radio communication receivers and audio transmission lines are required for recording radio code transmission.

CHAPTER 2
INSTALLATION

8. Unpacking

a. Packaging Data. Figure 2 illustrates a typical method of packaging and packing Code Recorder RD–60/U. The power cord is cushioned and packaged within the recorder case. The ink supply is tightly positioned beside the recorder within the inner corrugated carton with cushioning of suitable material. The dimensions of the wooden packing case are approximately 21 inches × 24 inches × 34 inches. The weight is 203 pounds; the volume is approximately 10 cubic feet.

Note. Some variation in packaging and packing may be encountered.

b. Removing Contents.

(1) Cut the metal straps just below the wooden cover.

(2) Use a nail puller and remove the nails.

(3) Remove the wooden cover and slit the moistureproof barrier.

(4) Open the outer corrugated carton and slit the moisture-vaporproof barrier.

(5) Open the inner corrugated carton and remove the contents.

(6) If the equipment is to be operated at the site of unpacking, remove the shipping clamp (fig. 3)on the tape drive mechanism within the recorder. Otherwise, leave the shipping clamp in place until the equipment has been positioned where it is to be used.

c. Checking Unpacked Equipment. Check the contents against the packing list. When no packing list accompanies the equipment, the table of components (par. 5) may be used as a general check to indicate the equipment which *probably* was packed.

9. Connections

Connections between the recorder input terminal board (fig. 4) and various types of equipment is given in the chart below. The input terminal board is located at the rear of recorder.

Note. For code practice network connections, refer to TM 11–2093.

Type of equipment and/or operation	Connection	
	From equipment	To recorder terminals
Telegraph key	Telegraph key terminals.	GROUND and CONTACT
Radio receiver:		
Tone signals	Loudspeaker voice coil direct or through impedance-matching transformer (impedance ratio equals approximately 10 to 1).	GROUND and TONE 500 OHMS
	Radio receiver output direct or through impedance-matching transformer (impedance ratio determined by output impedance of radio receiver and input impedance of recorder).	GROUND and F SHIFT
Frequency-shift signals	Radio receiver output.	GROUND and TONE 5000 OHMS
Audio transmission lines.	Two-wire line with ground.	GROUND and TONE 500 OHMS
	Two-wire line without ground (through isolation transformer).	GROUND and either TONE 500 OHMS or TONE 5000 OHMS

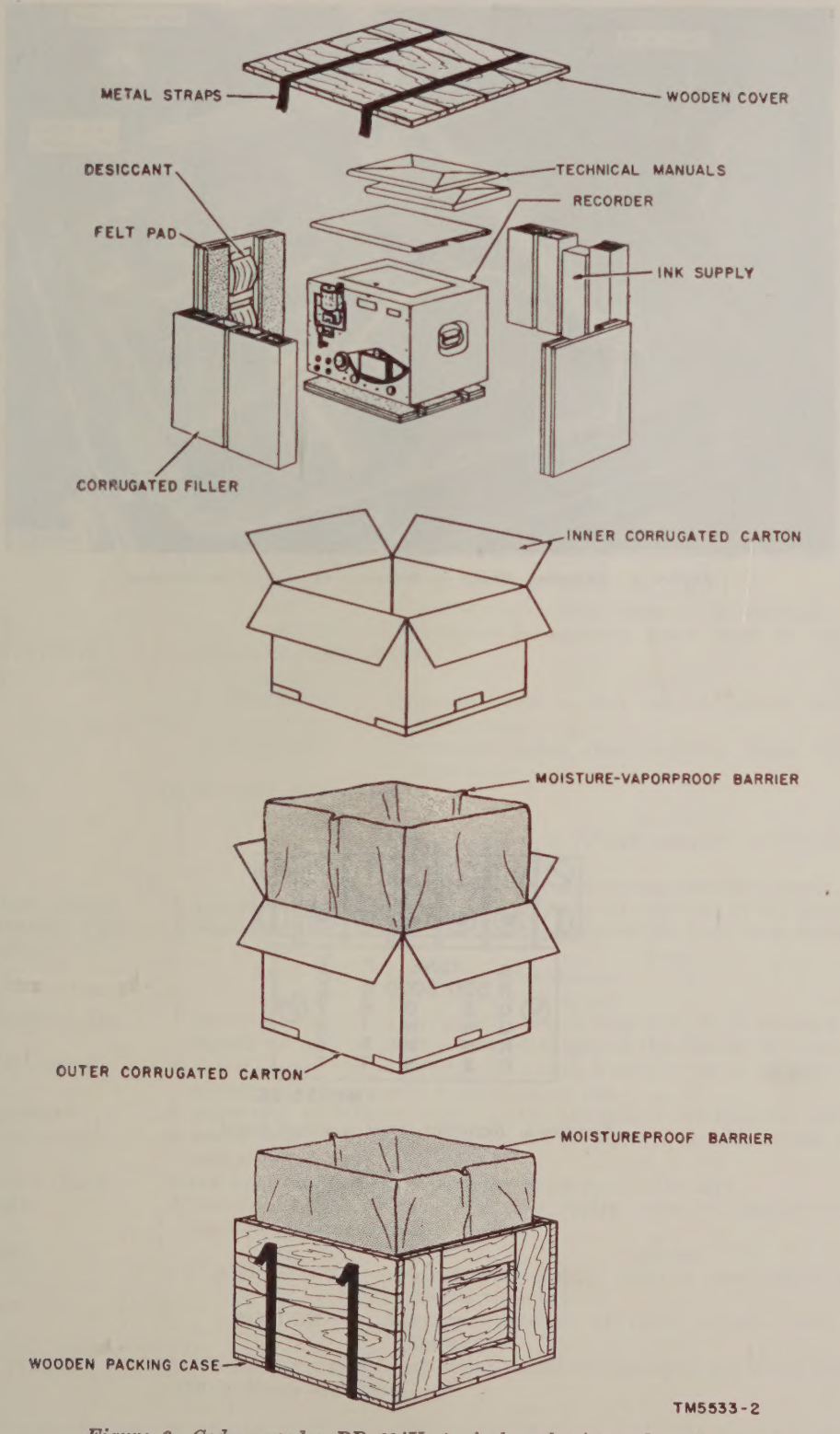


Figure 2. Code recorder RD–60/U, typical packaging and packing.

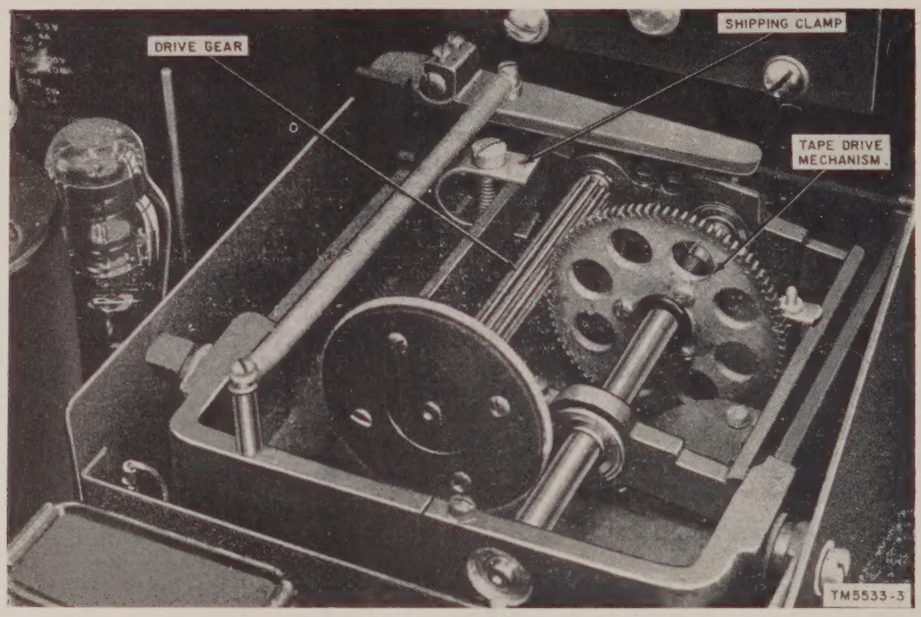
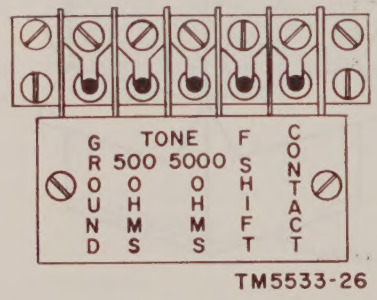


Figure 3. Shipping clamp in place on tape drive mechanism.



Figuure 4. Recorder input terminal board.

CHAPTER 3

OPERATION

Section I. PREOPERATION

10. Controls and Indicators (figs. 5 and 7)

Control or indicator	Description and function
SPEED RANGE switch	A two-position toggle switch.
	Position — *Function*
	HIGH — Selects high speed range for the tape drive mechanism.
	LOW — Selects low-speed range for the tape drive mechanism.
AC switch	A two-position toggle switch.
	Position — *Function*
	ON — Connects ac operating power to the equipment.
	OFF — Disconnects ac operating power from the equipment.
OPERATE-STANDBY switch	A two-position toggle switch.
	Position — *Function*
	OPERATE — Connects power to final amplifier stages and starts tape drive motor.
	STANDBY — Disconnects power from amplifier stages and stops tape drive motor.
FILTER switch	A two-position toggle switch.
	Position — *Function*
	IN — Connects filter in voltage amplifier circuit for removal of high noise peaks.
	OUT — Disconnects filter from voltage amplifier circuit.
PEN REVERSE switch	A two-position toggle switch which reverses the direction of the recorded ink line.
SPEED CONTROL FEET PER MINUTE.	A mechanical control which adjusts the speed of the tape drive mechanism.
	Scale — *Range*
	LOW — 0 to 35 (5-foot divisions)
	HIGH — 0 to 70 (10-foot divisions)
SIGNAL LEVEL control	A potentiometer control (arbitrarily scaled from 0 to 10 in divisions of 1) which adjusts the level of the input signal to provide the clearest ink line.
PEN POWER control	A potentiometer control (arbitrarily scaled from 0 to 10 in divisions of 1) which adjusts the driving power to the recording pen.
Inkwell valve control	A screw-type adjustment which controls the flow of ink from the inkwell.
Platen lever adjustment	A screw adjustment which controls the pressure of the pen on the tape and the tape platen.
Centering screws (fig. 6)	Screw adjustments which center the signal line on the tape.
MONITOR jack	A two-contact jack for connection of a headset when it is desired to monitor the input signal to the recorder.
Indicator lamps	*Lamp* — *Function*
	AMPLIFIER — Indicates connection of power to power supply and amplifier circuits when lighted.
	PULLER — Indicates connection of power to tape drive motor when lighted.
115 V–230 V switch*	A two-position toggle switch which adapts the equipment for either 115- or 230-volt, 50- to 60-cps operation.

* The 115 V–230 V switch is located in the right hand corner under the lid of the recorder.

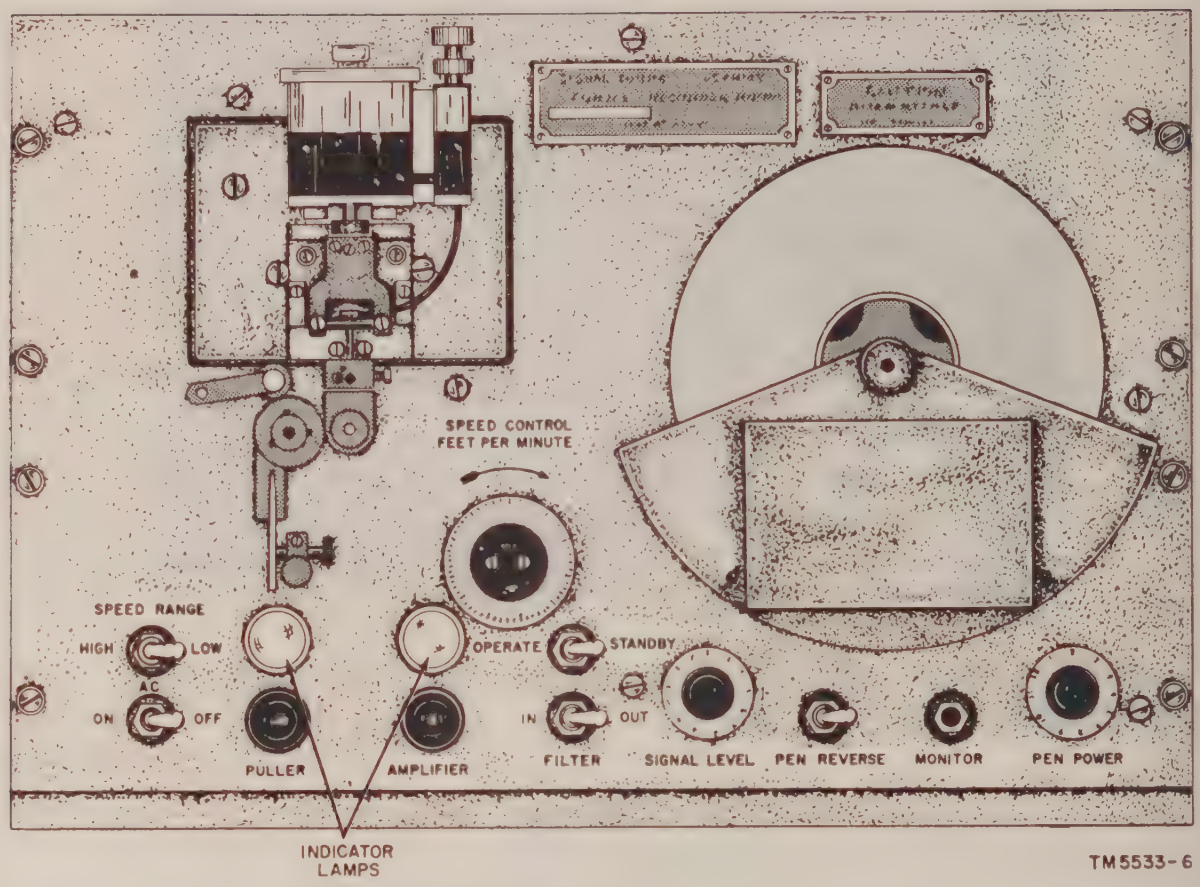


Figure 5. Recorder, front panel controls.

11. Ink and Pen Selection

a. Use carbon black ink when the tape is to be used for retransmission from a keyer. A good quality of writing ink may be used for sight reading.

b. Use the fine (.015 inch) or medium (.025 inch) pen when the recording tape is to be used for sight reading. Use the wide pen (.040 inch (.050 inch on Order No. 29871–Phila–55)) when the recording tape is to be used for retransmission.

12. Changing Pen and Ink Supply

a. Ink Supply (figs. 6 and 7).

(1) Gently close the inkwell valve by turning the inkwell valve control clockwise, and pull the rubber hose off the pen stem. The inkwell valve has a very shallow taper. Do not force the valve; use only enough pressure to shut off the ink effectively.

(2) Loosen the thumbscrew that holds the inkwell on the mounting bracket.

(3) Remove the inkwell by sliding it out of the slot in the mounting bracket.

(4) Pour out any remaining ink, and wash the inkwell with clear water.

Caution: Do not use alcohol, carbon tetrachloride, gasoline, or any cleaning compound for cleaning the inkwell.

(5) Wipe out the inkwell with a clean lint-free cloth to hasten drying.

Caution: Do not fill the inkwell until it is thoroughly dry, and do not use heat to dry the inkwell.

(6) Replace the inkwell by sliding it into the slot in the mounting bracket.

(7) Tighten the inkwell holding thumbscrew.

(8) Fill the inkwell as described in paragraph 13.

b. Pen (fig. 6). See that the inkwell valve is closed and the rubber hose removed before changing the pen (*a*(1) above).

(1) Remove the mounting screws that hold the pen block to the surface plate.

(2) Lower the pen block below the end of the pen, and remove the pen block.

(3) Remove the mounting screws that hold the pen and yoke assembly to the surface plate.

(4) Carefully slide the pen and yoke assembly to the left and remove the small bakelite sleeve from the end of the recording coil sleeve.

Note. The pen has a protruding shaft that fits into a sleeve on the end of the recording coil. Do not lose the small bakelite sleeve that serves as a bearing between the pen shaft and the sleeve at the end of

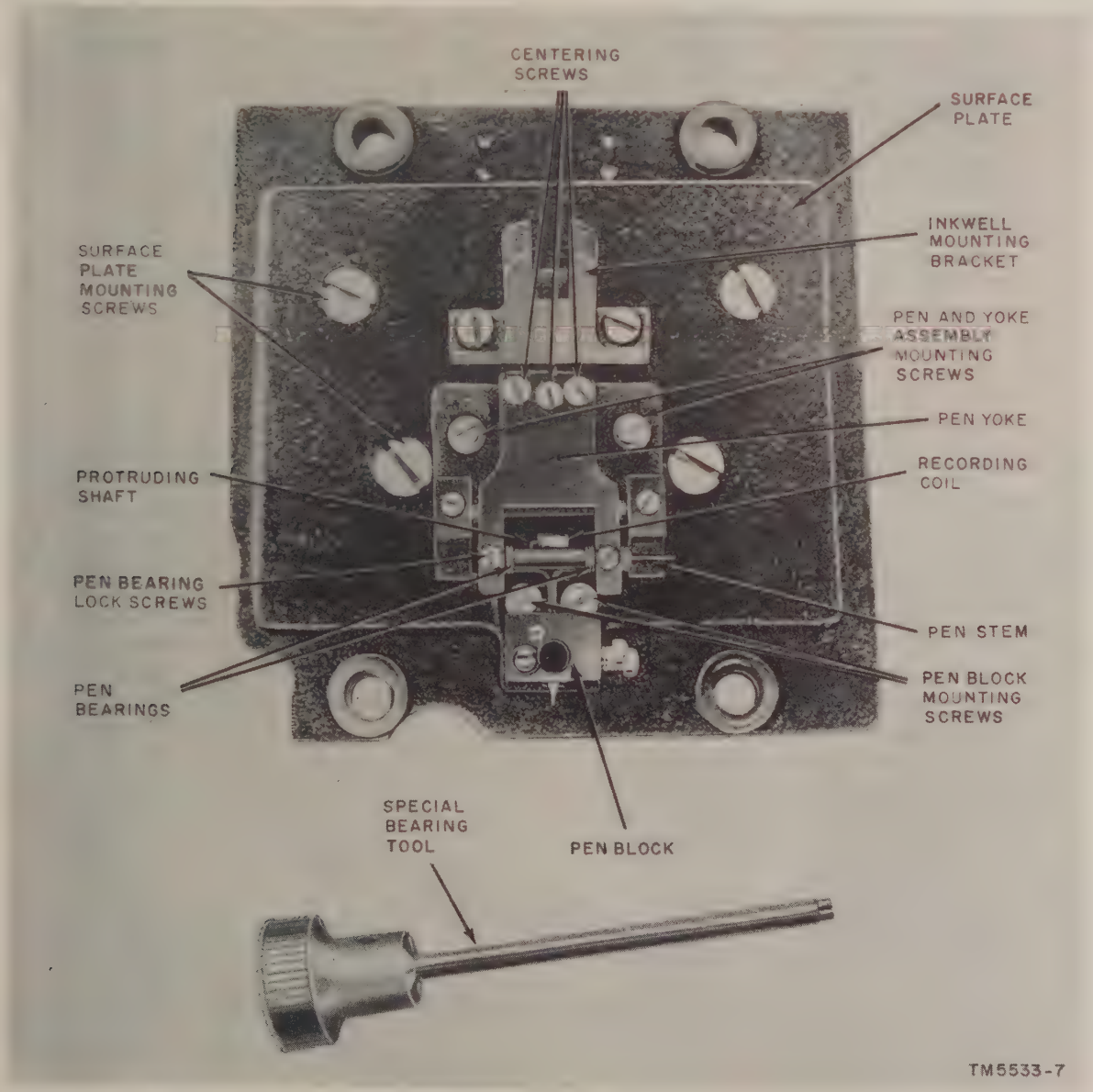


Figure 6. Pen and yoke assembly and special bearing tool.

the recording coil. The small bakelite sleeve must be used when installing another pen.

(5) Lift the pen and yoke assembly from the surface plate.

(6) Loosen the lock screws that hold the pen bearings.

(7) Use the special bearing tool to remove the right hand pen bearing, and remove the pen.

(8) Place the new pen in the stationary pen bearing in the pen yoke and replace the right hand pen bearing.

(9) Tighten the pen bearing lock screws until the pen is held firm. The pen must not wobble but must swing only in the direction normal to its stroke.

(10) Replace the small bakelite sleeve in the end of the recording coil sleeve.

(11) Slide the protruding shaft of the pen into the recording coil sleeve and line up the pen and yoke assembly mounting holes with the mounting holes on the surface plate.

(12) Replace and securely tighten the pen and yoke assembly mounting screws.

(13) Replace the pen block, and line up the pen block mounting holes with the mounting holes on the surface plate.

(14) Replace and securely tighten the pen block mounting screws.

(15) Replace the rubber hose.

13. Filling Inkwell

a. Gently close the inkwell valve (par. 12*a* (1)).

b. Remove the top cover from the inkwell.

c. Thoroughly clean the inkwell (par. 12*a*(4) and (5)).

d. Half fill the well with ink. Refer to paragraph 11*a* for the type of ink to use.

e. Replace the top cover on the inkwell.

f. Clean all excess ink from the outside of the inkwell with a cloth moistened with water.

Caution: Do not open the inkwell control valve at this time.

Section II. OPERATION

14. Preliminary Checks

Caution: Do not place watches or clocks near the RD–60/U. The powerful permanent-magnet field in the recorder will magnetize the springs of the mechanism and the timepiece will operate erratically or will stop.

a. Tubes and Fuses. Make the following checks before starting the equipment.

(1) Secure the tubes in their bases by pressing them down gently. Check to see that the tube clamps are secure.

(2) Check to see that a 3-ampere fuse is in the AMPLIFIER fuse holder; check to see that a 2-ampere fuse is in the PULLER fuse holder.

Caution: To avoid damage to the equipment, do not use fuses with ratings other than those specified in (6) above.

(3) Check to see that the shipping clamp on the tape drive mechanism has been removed (par. 8*b*(6)).

b. Initial Starting Procedures. The recorder can be operated from either a 115- or 230-volt, 50- to 60-cps source. Be sure that the 115 V-230 V switch is in the proper position for the applied voltage. A guard, mounted over the switch, prevents a change in the setting without removing the guard. The unit is shipped with the switch in the 115 V position.

(1) Operate the 115 V–230 V switch to the proper position.

(2) Operate the OPERATE-STANDBY switch to the STANDBY position.

(3) Connect the power cord to the 115–230 VAC 50/60 CYCLES receptacle (located at the rear of the recorder) and to the ac power source.

(4) Operate the AC switch to the ON position.

(5) Allow approximately 45 seconds warm-up time.

15. Threading Tape
(fig. 7)

a. Remove the hub from the tape bin.

b. Insert the hub into the center core of a blank

tape roll. Be sure that the tape runs off the bottom of the roll when the roll rotates clockwise.

c. Place the tape roll and hub in the tape bin.

d. Break the end of the tape and pull. The tape must rotate freely and pass off the roll without binding.

e. Be sure that no input signal is being applied and operate the OPERATE-STANDBY switch to the OPERATE position.

f. Push the tape platen lever to the left to disengage the tape platen from the pen.

g. Pass the tape between the pen and the tape platen and insert the end of the tape between the tape drive roller and the tape traction roller.

h. Release the tape platen lever. If the tape platen lever returns too far, the tape will tear as it passes between the pen end and the tape platen. Turn the platen lever adjustment until the pressure against the paper is reduced.

16. Adjustments

a. Ink Flow (fig. 7).

(1) Turn the inkwell valve control ½ turn counterclockwise to open the inkwell valve.

(2) Adjust the platen lever adjustment for a good clear ink line.

Note. If an ink line has a weak or scratchy appearance, turn the platen lever adjustment clockwise until the pressure between the tape platen and pen end is reduced. When there is no ink line or ink drips on the tape, turn the platen lever adjustment counterclockwise until the tape platen rises high enough to bring the surface of the tape in contact with the pen end.

(3) Tighten the platen lever locking thumbscrew.

b. Signal Level. The SIGNAL LEVEL and PEN POWER controls should be adjusted for recording good reliable signal characters, with no tendency to skip dots.

(1) Apply an input signal and adjust the SIGNAL LEVEL control until the pen follows the signal.

(2) Adjust the PEN POWER control until the pen has a good swing with no splattering of ink.

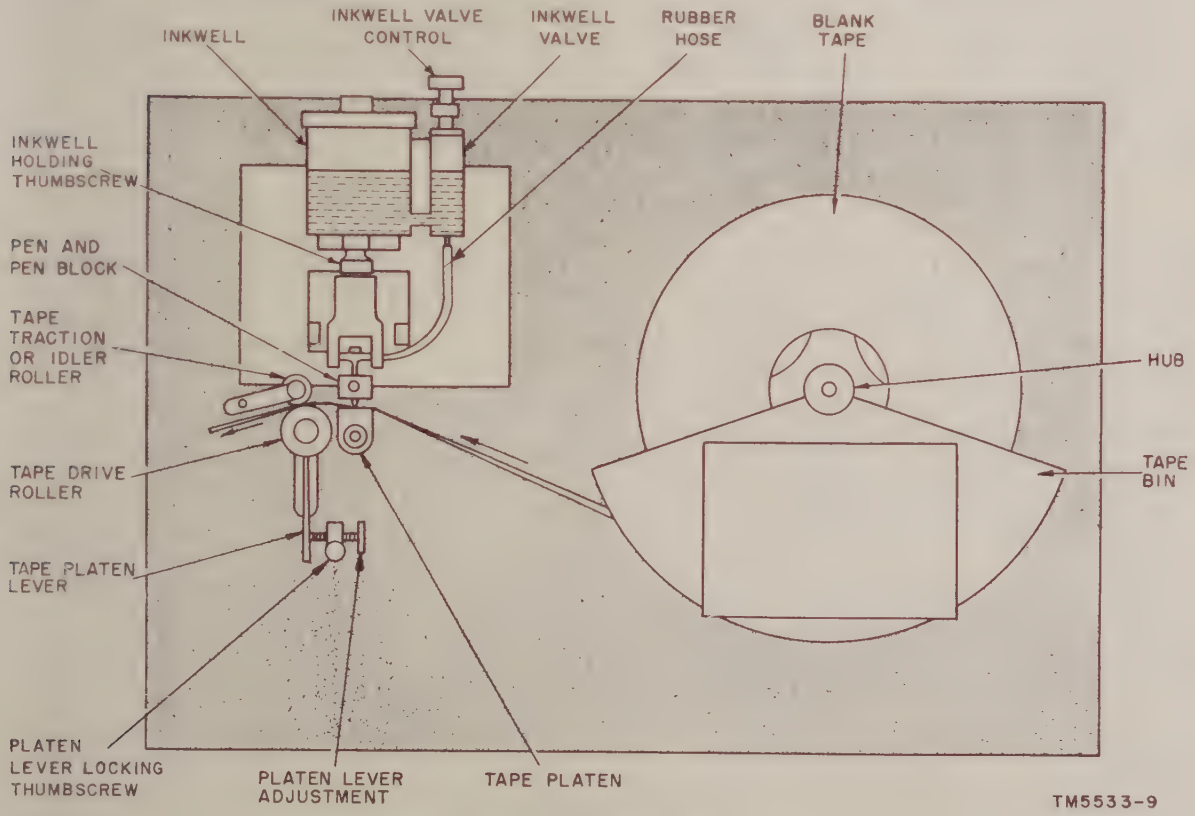


Figure 7. Threading tape.

c. Reversed Characters. Operate the PEN REVERSE switch to the opposite position when the inked characters appear upside down on the tape.

d. Tape Speed for Hand or Semiautomatic Key.

(1) Operate the SPEED RANGE switch to the LOW position.

(2) Adjust the SPEED CONTROL so that the dots appear to be approximately square. The dots are considered square when the upper or mark line is about the same length as the rise of the line from space to mark.

e. Tape Speed for High-speed Radio Transmission.

(1) Operate the SPEED RANGE switch to the HIGH position.

(2) Adjust the SPEED CONTROL so that the dots appear to be approximately square.

f. Noise Filter. Operate the FILTER switch to the IN position when high-speed transmissions are being recorded.

Note. The FILTER switch tends to level sharp noise peaks when signals accompanied by a noise background are being recorded from a radio receiver. The effect of the FILTER switch will scarcely be noticed at hand-keying levels.

17. Stopping Procedure

a. Turn the inkwell valve control clockwise to close the inkwell valve.

b. Allow the tape to run until all of the ink is drawn from the pen.

Caution: If all ink is not drawn from the pen it will harden and render the pen useless.

c. Operate the OPERATE-STANDBY switch to the STANDBY position.

d. Operate the AC switch to the OFF position.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. OPERATOR'S MAINTENANCE

18. Scope of Operator's Maintenance

Operator's (first echelon) maintenance of the RD–60/U includes general cleaning, adjusting, and tightening of mechanical parts. The operator will not replace parts, but will note deficiencies and refer them to organizational maintenance personnel for correction.

19. Tools and Materials Required

The tools and materials required for operator's maintenance are listed below.

a. Tools. The tools listed below are supplied as a part of the RD–60/U.

Item	Used to
Screw driver, 2½ in. lg	Tighten and replace missing screws.
Special bearing tool	Adjust and change pen.
Hexagonal key wrenches (Allen):	Tighten mechanical parts.
1 No. 6	
1 No. 8	
1 No. 10	
Cleaning wires:	Clean hardened ink from inside of pens.
1 wire ribbon, .0035 in. w by .024 in. thk (.004 in. w by .020 in. thk, Order No. 29871–Phila–55)	
1 wire, .0035 in. dia (.004 in. dia, Order No. 29871–Phila–55)	
1 wire, .007 in. dia	

b. Tools and Materials. The following tools and materials are required, but are not supplied as a part of the RD–60/U.

Item	Used to
Tweezers	Hold small parts.
Medicine dropper	Force water into the inking system.
Paint brush, 1 in.	Remove dust, dirt, and lint from switches, controls, and exterior of equipment.
Sandpaper, #0000, 9 in. by 12 in. sheets	Remove rust and corrosion from metal parts.
Orange stick	Remove fungus growth from apparatus.
Cleaning Compound (Federal Stock No. 7930–395–9542)	Clean grease, oil, and corrosion from equipment.

20. Operator's Preventive Maintenance

a. DA Form 11–250. DA Form 11–250 (fig. 8) is a preventive maintenance check list to be used by the operator. Items not applicable to the RD–60/U are lined out on the figure. References in the ITEM block in the figure are to paragraphs that contain additional maintenance information pertinent to the particular item. Instructions for the use of the form appear on the back of the form.

b. Items. The information in this subparagraph is supplementary to DA Form 11–250. The item numbers correspond to the ITEM numbers on the form.

Item	Maintenance procedures
2	Use a damp cloth to wash spilled ink from the tape platen, tape traction roller, and surrounding panel. Be sure that the recorder is in the normal vertical position so that water will not run into the recording coil and interior of the unit. Use a cloth moistened with Cleaning Compound* to remove paper lint, glue, and sizing from the tape drive roller.
4	Use a cloth moistened with Cleaning Compound to remove all dirt, corrosion and oil that cannot be removed with a dry cloth. Use #0000 sandpaper to loosen rust and corrosion. Do not use steel wool.

*Cleaning Compound is flammable and its fumes are toxic. Do not use near flame and provide adequate ventilation.

c. Additional Preventive Maintenance. In addition to performing the procedures specified in DA Form 11–250, the operator will clean the tape track, pen and inkwell cover ((1) through (3) below) daily, and the inkwell and rubber hose ((4) below) weekly.

(1) *Tape track.*

(*a*) Push the tape platen lever to the left and remove the tape platen.

(*b*) Blow out accumulated dust and paper lint in the tape track.

(*c*) Replace the tape platen.

(2) *Pen.*

(*a*) With the inkwell valve closed, pull the rubber hose off the pen stem.

(*b*) Run a cleaning wire through the pen from the point to the pen stem. Do not use a bent cleaning wire, and do not jerk the wire through the pen.

(*c*) Replace the rubber hose on the pen stem.

(3) *Inkwell cover.*

(*a*) Remove the inkwell cover and poke out any accumulated dirt and paper lint in the small hole. Be sure that no dirt falls into the inkwell. Dirt in the inkwell will clog the inking system.

(*b*) Replace the inkwell cover.

(4) *Inkwell and rubber hose.*

(*a*) Remove and clean the inkwell (par. 12*a*(1)—(5)).

(*b*) Force water through the rubber hose using the medicine dropper.

(*c*) Replace the inkwell and rubber hose.

Section II. ORGANIZATIONAL MAINTENANCE PROCEDURES

21. Scope of Organizational Maintenance

Organizational maintenance (second echelon) personnel are responsibile for performing the same preventive maintenance procedures as the operator (par. 20). In addition, organizational maintenance consists of the following:

a. Preventive maintenance (par. 23).

b. Lubrication (par. 25).

c. Replacement of defective tubes (par. 28).

d. Repair or replacement of cords and wiring.

e. Replacement and adjustment of the pen assembly (par. 12*b*).

22. Tools, Materials, and Test Equipment Required

In addition to the tools and materials required by the operator (par. 19) the following tools and test equipment are required for organizational maintenance of the RD–60/U.

Item	Used to
Tool Equipment TE–41	Remove and replace parts, and make adjustments.
Multimeter TS–297/U (TM 11–5500)	Make continuity and resistance measurements.
Electron Tube Test Set TV–7/U (TM 11–5083)	Test electron tubes.
Pen hone (oilstone)	Hone pens.

23. Organizational Preventive Maintenance

a. DA Form 11–251. DA Form 11–251 (fig. 9) is a preventive maintenance check list to be used by the organizational maintenance personnel. Items not applicable to the RD–60/U are lined out on the figure. References in the ITEM block in the figure are to paragraphs that contain additional maintenance information pertinent to the particular item. Instructions for the use of the form appear on the back of the form.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

PUBLIC ADDRESS, RECORDER, REPRODUCER

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
CODE RECORDER RD-60/U	10

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION						
		S	M	T	W	T	F	S
1	INSPECT UNIT FOR COMPLETENESS - ~~MICROPHONE~~, ~~HEADSET~~, [illegible], ~~CABLES~~, ACCESSORIES, RUNNING SPARES. PAR 5		✓	✓				
2	CLEAN EXTERIOR OF COMPONENTS OF DIRT, GREASE, GRIME, CORROSION, [illegible]. PAR. 20b		⊗	✓				
3	CLEAN PLUGS AND ELECTRICAL CONNECTIONS OF CORROSION, TARNISH, [illegible]		✓	✓				

WEEKLY

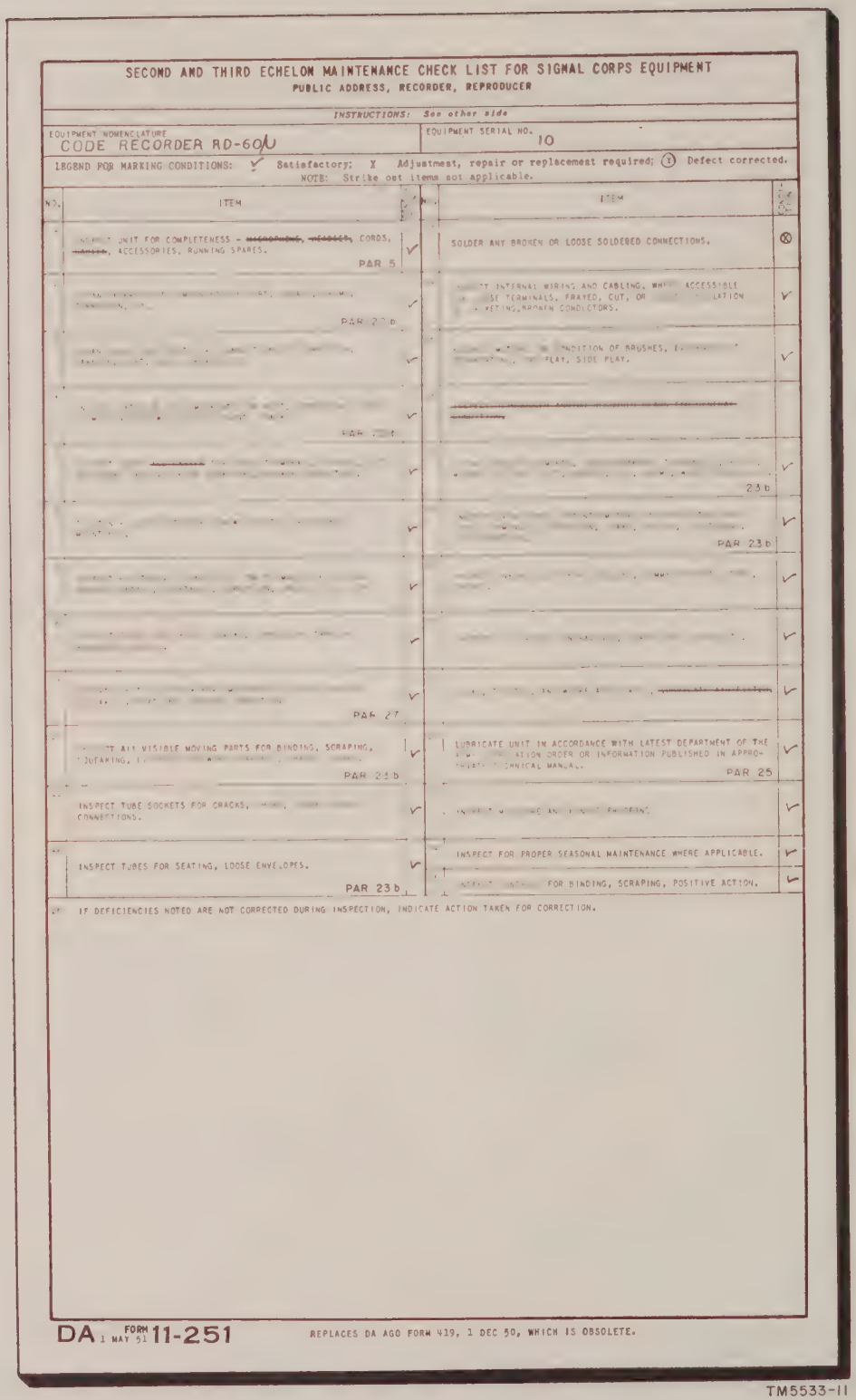
NO.	ITEM	IND. ITEM	NO.	ITEM	IND. ITEM
1	INSPECT EXTERIOR OF COMPONENTS FOR RUST, CORROSION, LOOSE OR MISSING SCREWS, CHIPPED PAINT, CRACKS. PAR. 20b	✓	4	[illegible] CONNECTIONS FOR FIRMNESS OF SEATING, [illegible], CORROSION, GREASE, OIL, DIRT.	✓
2	INSPECT CORDS ~~AND CABLES~~ FOR LOOSE TERMINALS, FRAYED, CUT OR GOUGED INSULATION OR JACKETING, BROKEN CONDUCTORS.	✓	5	[illegible] TARN[illegible], [illegible].	✓
3	TIGHTEN - LOOSE EXTERIOR SCREWS, [illegible]S, FASTENINGS, MOUNTINGS.	✓	6	OPERATE UNIT AND CHECK FOR [illegible], ABNORMAL NOISE, SQUEAKS, VIBRATIONS, [illegible]. PAR 27	✓

* IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, [illegible] TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-250 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM5533-10

Figure 8. DA Form 11–250.



SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
PUBLIC ADDRESS, RECORDER, REPRODUCER

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: CODE RECORDER RD-60A/U
EQUIPMENT SERIAL NO.: 10

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustmest, repair or replacemest required; (Y) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM		NO.	ITEM	
	[illegible] UNIT FOR COMPLETENESS - ~~MICROPHONE, HEADSET~~, CORDS, ~~CABLES~~, ACCESSORIES, RUNNING SPARES. PAR 5	✓		SOLDER ANY BROKEN OR LOOSE SOLDERED CONNECTIONS.	⊗
	[illegible] PAR 23b	✓		[illegible] INTERNAL WIRING AND CABLING. WHERE ACCESSIBLE [illegible] TERMINALS, FRAYED, CUT, OR [illegible] LATION [illegible] METING, BROKEN CONDUCTORS.	✓
	[illegible]	✓		[illegible] CONDITION OF BRUSHES, E[illegible] PLAY, SIDE PLAY.	✓
	[illegible] PAR [illegible]	✓		[illegible]	
	[illegible]	✓		[illegible] 23b	✓
	[illegible]	✓		[illegible] PAR 23b	✓
	[illegible]	✓		[illegible]	✓
	[illegible]	✓		[illegible]	✓
	[illegible] PAR 27	✓		[illegible]	✓
	[illegible] T ALL VISIBLE MOVING PARTS FOR BINDING, SCRAPING, [illegible]UEAKING, [illegible] PAR 25b	✓		LUBRICATE UNIT IN ACCORDANCE WITH LATEST DEPARTMENT OF THE [illegible] ATION ORDER OR INFORMATION PUBLISHED IN APPRO[illegible] TECHNICAL MANUAL. PAR 25	✓
	INSPECT TUBE SOCKETS FOR CRACKS, [illegible] CONNECTIONS.	✓		[illegible]	✓
	INSPECT TUBES FOR SEATING, LOOSE ENVELOPES. PAR 23b	✓		INSPECT FOR PROPER SEASONAL MAINTENANCE WHERE APPLICABLE.	✓
				[illegible] FOR BINDING, SCRAPING, POSITIVE ACTION.	✓

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-251 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM5533-11

Figure 9. DA Form 11–251.

b. Items. The information in this subparagraph is supplementary to DA Form 11–251. The item numbers correspond to the ITEM numbers on the form.

Warning: When power to the equipment is disconnected, some capacitors may still retain voltage of dangerous potential. Before touching exposed electrical parts, short-circuit the part to ground. When maintenance is completed, replace the equipment in its case and check for satisfactory operation.

Item	Maintenance procedures
10	Examine the fricton drive wheel and replace if excessive wear or erratic operation is observed.
12	Press the tubes and the plug-in electrolytic capacitor firmly into their sockets.
17	Wipe the tape drive motor cone and friction drive wheel with a lint-free cloth moistened with Cleaning Compound*. Remove all oil and grease.
18	If the selenium rectifier shows signs of darkening and excessive heat, field maintenance is required. Inspect the plug-in electrolytic capacitor for swelling or discoloration and replace if necessary.

* Cleaning Compound is flammable and its fumes are toxic. Do not use near flame and provide adequate ventilation.

c. Pen Honing (fig. 10). A thin, scratchy, or ragged ink line, observed during the check for normal operation of the RD–60/U, indicates that the pen requires honing. Dress the pen with the pen hone supplied in the special tool kit.

(1) Draw the pen hone lightly across the end of the pen in the direction of tape travel.

(2) End the stroke by abrading the hollow-ground edge of the pen.

24. Chassis Removal and Parts Accessibility

The tubes and plug-in electrolytic capacitor are easily reached by opening the lid on the top of the recorder. To reach the tape drive motor and underside components, follow the procedures below:

a. Remove the oval-head panel screws and metal grommets.

b. Slide the front panel and chassis forward and out of the case.

c. Remove the screws that hold the bottom cover on the bottom of the chassis.

25. Lubrication
(fig. 11)

Note. Disassembly is not required for lubrication of the RD–60/U.

a. Lubrication Chart.

Caution: Do not apply excess grease to the drive gear and pinion. The excess grease will spread to the tape drive motor cone and friction drive wheel, when the operating temperature of the unit increases. If the friction bond between these two components is destroyed, the equipment will not operate.

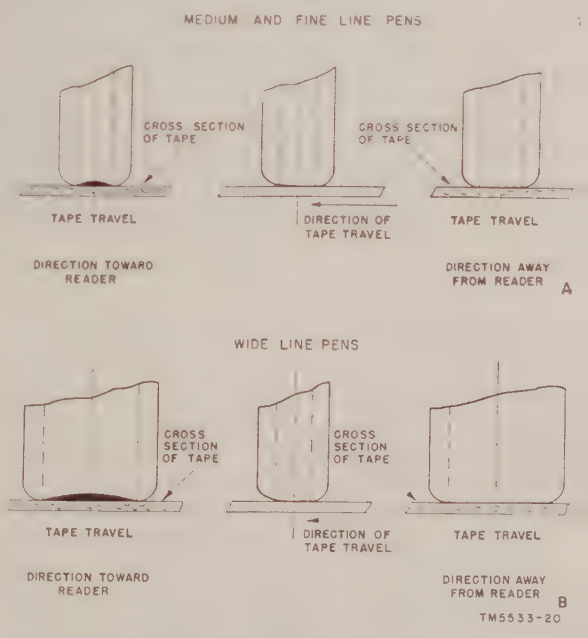


Figure 10. Profiles of inking pens.

Part	Lubricant	Quantity of lubricant	Lubrication period
Solenoid lever bearings	Lubricating Oil, General Purpose Preservative (PL Special)	1 or 2 drops	Monthly
Drive gear and pinion	Grease, Graphite (GG), Grade 1	Thin film	Semiannually

Part	Lubricant	Quantity of lubricant	Lubrication period
Speed control frame lift shaft	PL Special	1 or 2 drops	Semiannually
Pen bearings	GG	Thin film	Annually
Tape idler lever bearings	PL Special	1 or 2 drops	Annually
Speed control gear and pinion	GG	Thin film	Annually

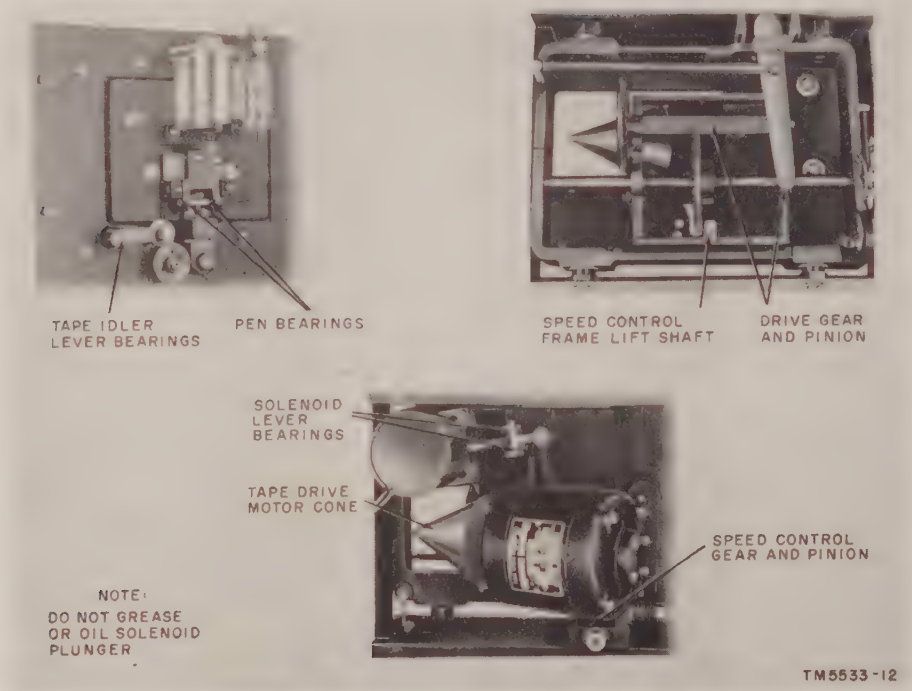


Figure 11. Lubrication points for Code Recorder RD–60/U.

b. Lubrication Under Extreme Temperature Conditions. The recorder has a friction drive to which the operator must give special attention during conditions of high heat and humidity. High temperatures may cause lubricating greases and oils to spread to the tape drive motor cone and friction drive wheel. Wipe the cone occasionally with a clean, dry cloth while the unit is in operation and the cone is rotating. If a film of grease and oil has spread to the cone and has penetrated the disk, clean the disk and cone with Cleaning Compound.

26. Visual Inspection

a. Before making an operational check of the equipment, inspect it. This will save repair time and may also avoid damaging the RD–60/U. Failure of the equipment to operate properly is usually caused by one or more of the following:

(1) Worn, broken, or disconnected leads.
(2) Burned-out fuses.
(3) Defective tubes.
(4) Worn friction drive wheel.
(5) Defective tape drive motor.
(6) Worn pen bearings.
(7) Dirt in the inking system.

b. The equipment performance check list (par. 27) will help to locate troubles that are not obvious. Check the items in numerical sequence.

c. If the trouble cannot be corrected by organizational maintenance personnel, troubleshooting at a higher echelon is necessary.

27. Equipment Performance Check List

Connect a signal source (par. 9) to the recorder before performing the following procedures.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	1	AC switch	Operate to OFF position.		
	2	Power cord.	Connect from recorder to 115- or 230-volt, 50- to 60-cps source.	Connectors fit securely.	Apply proper pressure on connectors.
	3	115 V-230 V switch.	Move to position equivalent to line voltage.	Factory set at 115 V position.	Guard must be removed to change switch position.
	4	OPERATE-STANDBY switch.	Operate to STANDBY position.		
	5	Inkwell valve control.	Turn clockwise to close valve.		
	6	Inkwell.	Half fill with ink.		
	7	Tape hub.	Place tape hub inside roll of tape.	Tape runs off bottom of roll when roll rotates clockwise.	Reverse hub.
	8	Tape bin.	Place tape roll in bin.	Tape rotates freely without binding.	Slam tape on table top to correct warp of tape roll.
	9	Tape.	Break end of tape and pull.	Tape is prepared for threading.	
START	10	AC switch.	Operate to ON position.	AMPLIFIER indicator lamp and tube filaments light.	Check power cord. Check AMPLIFIER fuse (par. 8c (6)). Check AMPLIFIER indicator lamp. Check the tubes (par. 28).
	11	OPERATE-STANDBY switch.	Operate to OPERATE position.	PULLER indicator lamp lights, tape drive roller rotates, and friction drive wheel makes contact with tape drive motor cone.	Check PULLER fuse (par. 8c(6)). Check friction drive wheel (par. 23b). Check plug-in electrolytic capacitor (par. 23b). Replace defective fuses, tubes, indicator lamps, and friction drive wheel.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PERFORMANCE EQUIPMENT	12	Tape.	Insert between pen and tape platen, and between tape drive roller and tape traction roller.	Tape moves between pen and tape platen, and between tape drive roller and tape traction roller.	Check the platen lever adjustment (par. 15*b*).
	13	Inkwell valve control.	Turn counterclockwise to open valve.	Ink line flows smoothly on tape.	Check platen lever adjustment (par. 16*a*).
				Ink line is centered on tape.	Check centering screws (par. 42*c*).
	14	SPEED RANGE switch.	Operate to HIGH position.	Tape speed increases.	Check switch.
			Operate to LOW position.	Tape speed decreases.	Check switch.
	15	SPEED CONTROL FEET PER MINUTE.	Turn clockwise.	Tape speed increases.	Check control.
	16	SIGNAL LEVEL control.	Turn clockwise.	Ink line follows signal.	Check control.
	17	PEN POWER control.	Turn clockwise.	Pen swings without splattering ink.	Check control.
	18	MONITOR jack.	Connect a headset to monitor jack.	Signal tone is present in headset.	Check headset. Check signal source.
	19	FILTER switch.	Operate to IN position.	Smoother signal line is observed during reception of high-speed signals.	Check switch.
	20	PEN REVERSE switch.	Operate to opposite position.	Signal line reverses on tape.	Check switch.
STOP	21	Inkwell valve control.	Turn clockwise.	Ink flow shuts off.	Check control.
	22	OPERATE-STANDBY switch.	Operate to STANDBY position.	PULLER indicator lamp is extinguished and tape drive roller stops.	Check switch.
	23	AC switch.	Operate to OFF position.	AMPLIFIER indicator lamp is extinguished.	Check switch.

28. Tube Replacement

If the equipment performance check list (par. 27) indicates the possibility of a defective tube, use the procedure outlined below to avoid excessive replacement of electron tubes.

a. Inspect cables, connections, and the general condition of the equipment before removing electron tubes.

b. Isolate the tube trouble, if possible, to a particular stage of the recorder.

c. If a tube tester is available, remove and test one tube at a time. Substitute new tubes only for those that are defective.

d. If a tube tester is not available, trouble shoot by the tube substitution method. Replace any suspected tubes, one at a time, with new tubes. Note the sockets from which the original tubes were removed. If the equipment becomes operative, discard the last tube removed. *Do not leave a new tube in a socket if the equipment operates satisfactorily with the original tube.*

Note. If a replacement for a bad tube becomes defective, check the adjustment and condition of component parts of the tube circuit. Otherwise, continued tube replacement will effect only temporary repair and more serious troubles may result.

e. If tube substitution does not correct the trouble, *reinsert the original tubes in the original sockets* before forwarding the defective equipment to a higher echelon for repair.

f. Discard tubes when:

(1) A test in a tube tester or other instrument shows that the tube is defective.

(2) The tube defect is obvious. *For example,* the glass envelope is broken or a connecting prong or lead is broken.

g. Do not discard tubes merely because the tubes have been used for a specified length of time. *Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new one.*

h. Do not discard tubes merely because they fall *on or slightly above* the minimum acceptable value when checked in a tube tester. It must be recognized that a certain percentage of new tubes fall near the low end of the acceptable range of the tube specification and, therefore, start their life at a value fairly close to the tube tester *retention limit.* These tubes may provide satisfactory performance throughout a long period of operational life at the *near limit* value.

i. Be careful when withdrawing a miniature tube from its socket. Do not *rock or rotate* the top of a miniature tube when removing it from a socket; pull it straight out. The external pin and the wire lead sealed in the glass base are two different metals which are butt-welded together where the pin appears to enter the glass. Rocking or rotating the tube bends the pins, and this tends to break the weld or cause a resistance or intermittent joint to develop.

j. The following electron tubes are supplied with recorders procured on Orders No. 29871–Phila–55 and 21597–Phila–56 and should be used as replacements in all equipments.

Reference designation	Type
V1	6SK7GTY
V2	6H6WGT
V3	6SJ7Y
V4	6L6WGB
V6	6X4W

Note. Tube V5 is type 5V4G on all orders.

CHAPTER 5
THEORY

29. General

The recording of signals with Code Recorder RD–60/U involves moving a $^{3}/_{8}$-paper tape under a pen. Ink is furnished for the pen by a rubber hose from an inkwell. Signals applied to the recorder are converted to rectangular-signal pulses which control a side-to-side movement of the pen on the tape. The movement of the tape under the pen and the side-to-side movement of the pen provide an inked signal line which can be read directly or retransmitted.

30. Block Diagram Analysis
(fig. 12)

a. The signal path through the RD–60/U and the recording action are as follows:

(1) The input signal, which may vary in amplitude, is applied through input terminal board E1 to variable gain input stage V1. The variable gain input stage amplifies and levels off any changes in the amplitude of the signal.

(2) The output of tube V1 is applied to signal rectifier V2. The applied signal is rectified to a negative square-wave-type signal. A portion of the rectified output is returned to the variable gain input stage serving as an automatic volume control (avc).

(3) The output of signal rectifier V2 is filtered and applied to voltage amplifier V3 which is a sharp cutoff stage. Voltage amplifier V3 amplifies the applied signal and removes all remaining ripple.

(4) The output of tube V3 is applied to power amplifier V4, where the signal is again increased in amplitude.

(5) The output of tube V4 is applied through output transformer T2 to recording coil L2. Output transformer T2 converts the signal to high power peaks only during applied signal voltage changes (rise and fall time of the square-wave-type signal). A high power peak energizes the recording coil which draws the pen to one side. The direction or movement of the pen depends on the position of the PEN REVERSE switch and the polarity of the high power peak.

(6) Power from the ac source is applied to tape drive motor B1. Thus, the tape is continuously moving under the pen during the recording process.

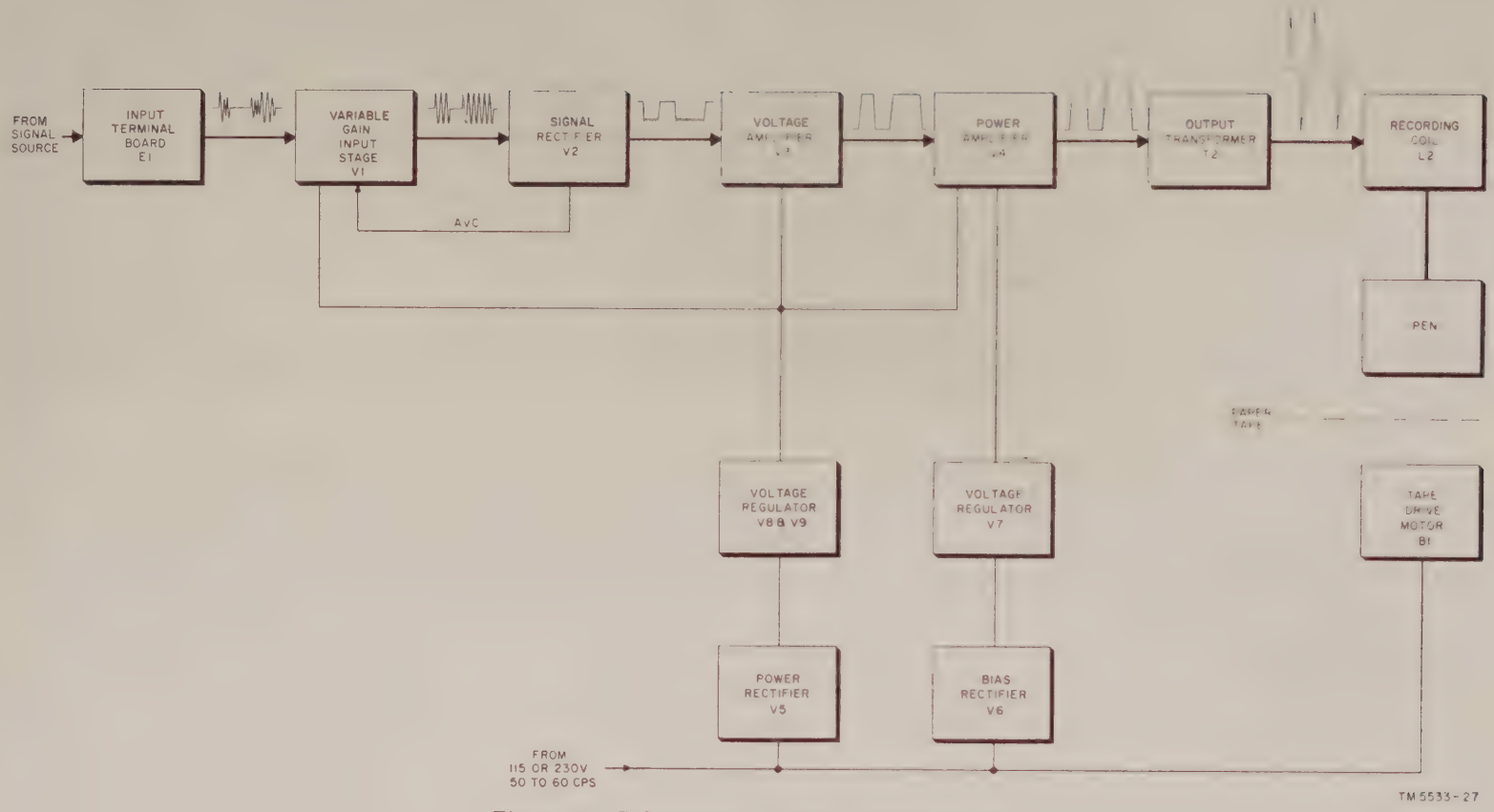
(7) The pen is held to one side by the field of a permanent magnet when a high-power peak collapses. A high-power peak of the opposite polarity is required to draw the pen to the other side, where the pen is again held by the field of the permanent magnet. During the rise time of the high-power peak the pen is drawn to one side and remains in that position until the rise time of the power peak of the opposite polarity; this provides a mark- and space-type ink line on the paper tape.

b. The power supply functions as follows:

(1) Power from the ac source is applied to power rectifier V5. The rectified output of tube V5 is regulated by tubes V8 and V9, and supplies the necessary direct-current (dc) potentials for the plates and screen grids of tubes V1, V3, and V4.

(2) Power from the ac source is applied to bias rectifier V6. The rectified output of tube V6 is regulated by voltage regulator V7, and supplies a fixed bias for tube V4.

(3) The filament voltages, not shown on figure 12, are supplied to all tubes from the power supply.



Figuure 12. Code Recorder RD–60/U, block diagram.

31. Stage Analysis
(fig. 22)

a. Variable Gain Input Stage V1. Input stage V1 uses a remote cutoff pentode. The gain of this stage depends on the input grid bias. With no signal voltage, the tube bias is developed across cathode resistor R3. With a signal voltage applied, an automatic volume control (avc) voltage is used as bias for the control grid. The signal voltage fed to the control grid of tube V1 is amplified and fed to tube V2, where it is rectified and returned to the control grid in the form of an avc voltage. An increase in signal voltage increases the avc voltage, which decreases the gain of tube V1. A decrease in signal voltage decreases the avc voltage and increases the gain of tube V1. To prevent modulating tube V1, capacitor C2 reduces the audio or tone component in the rectified avc voltage. Resistor R1 provides a 500-ohm input impedance. Resistors R1 and R2 combined provide a 5,000-ohm input impedance. Capacitor C1 couples the input signal to the control grid of tube V1. Resistor R5 is the grid return resistor, and resistor R3 is the cathode bias resistor. Since resistor R3 is not bypassed, it provides negative feedback. Monitor jack J1 is provided for monitoring the signal applied to tube V1. Resistor R4 isolates the cathode from the impedance of the headset. Resistor R6 is the screen dropping resistor, and capacitor C3A is the screen bypass capacitor. The primary winding of transformer T1 is the plate load for tube V1.

b. Signal Rectifier Stage V2. The signal voltage appearing across the primary winding of transformer T1 is increased in the secondary winding because of the step-up action of the transformer. The center-tapped secondary winding of transformer T1 supplies two voltages for the cathodes of tube V2 which are equal, but opposite in phase. Since the plates of tube V2 are connected together, the action of tube V2 is that of a full-wave rectifier. The rectified signal voltage appearing across SIGNAL LEVEL potentiometer R9 is negative with respect to ground. A portion of the rectified signal voltage is fed through resistor R7 as the avc voltage for the control grid of V1. Choke L1 and capacitor C4 provide filtering action for the rectified signal. Choke L1 and capacitor C4 are resonant at a frequency of less than the fifth harmonic of the highest keying frequency at which the recorder will operate. The filter will pass the keying frequency and the third and fifth harmonics of the frequency; thus the keying envelopes are passed without rounding off the leading and trailing edges. Resistor R8 isolates the load of the signal rectifier stage from a signal source connected to the F SHIFT terminal of terminal board E1. SIGNAL LEVEL potentiometer R9 is the load resistance for the signal rectifier stage, and provides a means of controlling the signal level to voltage amplifier stage V3.

c. Voltage Amplifier Stage V3. The rectified signal from the arm of potentiometer R9 is directly coupled to the control grid of tube V3. Tube V3 is a sharp cutoff pentode, which acts similar to a limiter stage. Since the rectified signal is negative with respect to ground, tube V3 will cut off when a certain negative value is reached. Thus tube V3 amplifies the applied signal and eliminates the ripple or tone frequency on the keying envelope. Screen dropping resistor R10 is used only when FILTER switch S1 is in the IN position. Capacitor C38 is the screen bypass capacitor. Capacitor C5 tends to reduce high peak noise levels when switch S1 is in the IN position. The filtering action of capacitor C5 is effective only during high-speed transmissions. The amplified signal across plate load resistor R11 is directly coupled through isolation resistor R12 to the control grid of tube V4.

d. Power Amplifier Stage V4. In the absence of an applied signal to the recorder, the current through resistor R11 is high enough to drop the voltage at the plate of tube V3 to about 5 volts. Under this condition the control grid of tube V4 has a fixed negative bias of approximately 30 volts. This bias prevents the incoming signal voltage from making the control grid of tube V4 too positive with respect to the cathode. Tube V4 increases the amplitude of the signal which is fed to output transformer T2. Resistor R13 is the grid return resistor and part of a voltage divider network. Capacitor C7A is used as a bypass for the bias rectifier output. Unbypassed cathode resistor R14 provides sufficient negative feedback so that grid signals produce no output when the OPERATE-STANDBY switch is in the STANDBY position. Capacitor C7B is the screen bypass capacitor. The primary winding of transformer T2 is the plate load and capacitor C6 is a filter to flatten the high-frequency response and pre-

vent parasitic oscillations. A connection from the CONTACT terminal of terminal board E1 to the control grid of tube V4 provides a means of direct keying from a hand key.

e. Recording Coil L2. Since the transformer will only react to a change in signal, the square-wave signals in the primary winding of transformer T2 become mark and space pulses of high amplitude and short duration in the secondary winding. The rise of a square wave in the primary winding provides a pulse with a definite polarity in the secondary winding, which is referred to as a mark pulse. The fall of the square wave provides a pulse of the opposite polarity, which is referred to as a space pulse. When the square wave is at maximum, or minimum, there is no change and therefore no output from the secondary. The pulses from the secondary winding of transformer T2 are applied through PEN REVERSE switch S3 to the recording coil. A small blade of magnetic material is a part of the recording coil assembly and travels within a magnetic slot. The blade is held by a permanent-magnet field at the extreme of the mark position of the magnetic slot, and also at the extreme of the space position of the magnetic slot. During the travel time between the mark and space positions of the magnetic slot, no restraint is applied to the blade other than the friction of its mass and the friction of the blade and pen assembly bearings. The polarity of a mark pulse in the recording coil pulls the blade to the mark position of the magnetic slot. The peak driving pulses from transformer T2 are high, and provide high driving power to the recording coil. PEN REVERSE switch S3 provides a means of reversing the mark and space portions of the ink line on the recording tape.

32. Power Circuits
(fig. 22)

a. Input Circuit. The 115- or 230-volt 50- to 60-cps source is applied through the power cord and plug P1 to the recorder. Switch S4 (115 V-230 V) selects the proper number of turns in the primary winding of transformer T3 for 115- or 230-volt operation. Indicator I1 provides an indication that power is applied to the amplifier section of the recorder; indicator lamp I2 provides an indication that power is applied to the drive motor system. PULLER fuse F2 prevents the drive motor system from drawing excessive current, and AMPLIFIER fuse F1 prevents transformer T3 from drawing excessive current.

b. Drive Motor System. Tape drive motor B1 is a two-speed ac motor. The two speeds are determined by two separate field windings controlled by SPEED RANGE switch S6. Phasing capacitor C9 provides the 90° phase difference between the windings. Solenoid L3, when energized, draws the drive frame (fig. 13) into position for the friction drive wheel and tape drive motor cone to make contact. Solenoid L3 requires dc power, which is furnished through selenium rectifier CR1 and electrolytic capacitor C8. When the friction drive wheel makes contact with the tape drive motor cone, the tape drive roller (fig. 7) draws the recording tape between the inking pen and tape platen. The tape drive motor and solenoid will operate only when OPERATE-STANDBY switch S2 is in the OPERATE position.

c. Power Rectifier. Full-wave, power rectifier tube V5 furnishes the plate and screen grid voltages for the various stages. Capacitors C10 and C11 with choke L4 provide the filtering action. Resistor R15 is the voltage regulating resistor for tubes V8 and V9. Resistors R16 through R19 make up the voltage divider network. PEN POWER potentiometer R18 provides a means of adjusting the screen voltage of tube V4. The plate and screen voltages of tubes V1 and V3 and the screen voltage of tube V4 are regulated by voltage regulator tubes V8 and V9. The regulators sustain the screen voltage of tube V4 during the mark period when the tube is drawing a very large current.

d. Bias Rectifier. Full-wave, bias rectifier tube V6 furnishes a fixed bias for the control grid of tube V4. Capacitor C12 provides the filtering action, and resistors R12 and R13 make up the voltage divider network acting in accordance with the current flow through resistor R11. Resistor R20 is the voltage regulating resistor for tube V7. Voltage regulator V7, connected across voltage divider resistors R21 and R22, provides a constant bias voltage.

e. Filament Voltage. The filament voltage for tubes V1 through V4 and tube V6 is supplied by the 4–5 winding of transformer T3. The filament voltage for tube V5 is supplied by the 12–13 winding of transformer T3.

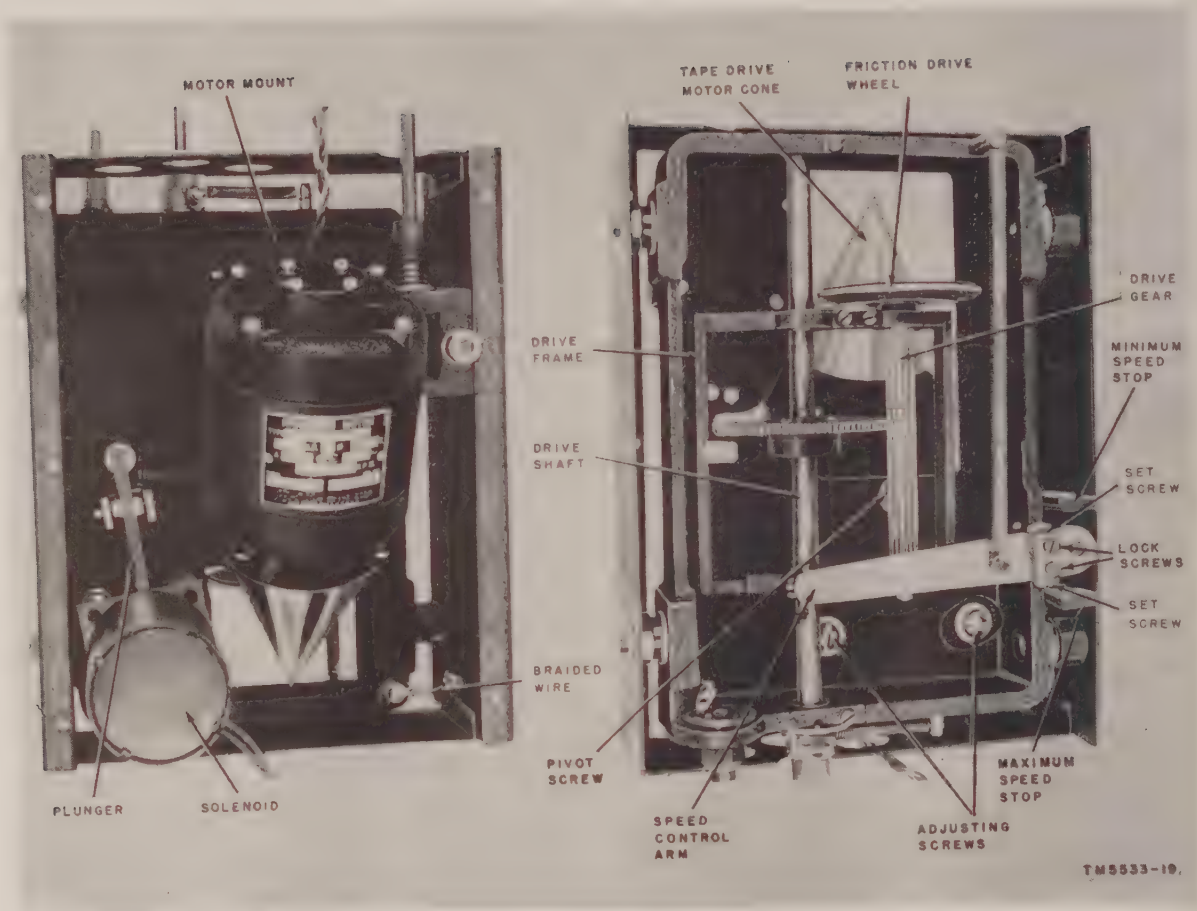


Figure 13. Tape drive assembly.

CHAPTER 6

FIELD MAINTENANCE

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warnings:

1. Certain points located throughout the chassis of the recorder are more than 250 volts above ground. Refer to figures 17 and 22. Do not touch these points while the power is on.

2. The failure of selenium rectifiers results in the liberation of poisonous fumes and the deposit of poisonous selenium compounds. If the rectifier burns out or arcs over, the odor is strong. Provide adequate ventilation immediately. *Avoid inhaling the fumes and do not handle the damaged rectifier until it has cooled.*

33. Troubleshooting Instructions

Troubleshooting at field maintenance level includes all the techniques outlined for organizational maintenance (pars. 18–28) and other techniques required to isolate a defective part. The field maintenance instructions supplement the instructions given in chapter 4. The systematic troubleshooting procedure, which begins with the operational checks covered in the equipment performance check list (par. 27), should be completed by means of the localizing and isolating techniques given in paragraphs 36 through 39.

34. Troubleshooting Techniques

a. General. To be effective, troubleshooting must be systematic. Generally, it will be necessary to perform a sequence of operational checks, observations, and measurements before a fault is revealed. If the proper sequence is used, the trouble will be first traced to a portion of the RD–60/U and then to the defective part. This sequence of steps is known as the localization and isolation of trouble.

b. Localization. Trouble can be localized to a portion of the RD–60 U by visual and operational checks and by signal tracing (par. 37).

Caution: Do not apply power to the recorder unless the operational symptoms are known, and are of such a nature as to eliminate the possibility of further damage when power is applied. If the symptom is not known, or indicates the possibility of a short circuit, make short-circuit checks before applying power.

c. Isolation. After the trouble has been localized to a stage, use visual inspection, voltage measurements, and resistance measurements to determine the defective part. Procedures for isolating defective parts are detailed in paragraphs 38 and 39.

35. Tools, Materials, and Test Equipment Required

The materials listed in paragraph 19, and the following tools, materials, and test equipment are required for trouble shooting at field maintenance level.

a. Tools and Materials Required. Tool Equipment TE–113 and Moisture and Fungiproofing Equipment MK–2/GSM are required for field maintenance.

b. Test Equipment Required.

Test equipment	Technical manual	Common name
Audio Oscillator TS–382A/U	TM 11–2684A	Signal generator
Multimeter TS–352/U	TM 11–5527	Multimeter
Electron Tube Test Set TV–7/U	TM 11–5083	Tube tester
Oscilloscope OS–8A/U	TM 11–1214	Test scope
Voltmeter, Meter ME–30A/U		Vtvm

36. General Troubleshooting

a. Troubleshooting Data. Listed below are tests and data that simplify the tracing of trouble. Follow the procedures in the sequence given. In general, the trouble is traced first to a circuit of the equipment and then to the faulty part in that circuit. The service procedures is summarized as follows:

(1) *Visual inspection* (par. 26). Through visual inspection alone, the repairman may discover the trouble or locate the circuit in which the trouble exists. Visual inspection can prevent additional damage to the equipment.

(2) *Troubleshooting chart* (par. 38). The trouble symptoms listed in this chart will aid greatly in localizing trouble.

(3) *Signal substitution.* When the proper signal generators are available, it may be preferable to use signal substitution in some cases.

(4) *Electrical troubles.* Do not disturb the wiring any more than is necessary when inspecting and testing. Most electrical troubles will be found in connections or at contacts of switches, controls, and jacks, or where insulation on wire or between metal parts has been damaged. Use a milliammeter or voltmeter to prove the location of electrical troubles. Refer to the schematic and wiring diagrams (figs. 22 and 23) and make point-to-point tests until the fault is located. Voltage and resistance measurements are shown in figures 16 and 17. Location of parts is shown in figures 14 and 15.

(5) *Mechanical troubles.* When a mechanical component fails or performs in a faulty manner, localize the trouble by making a particular adjustment or series of adjustments in the mechanism. Help in locating mechanical troubles may be secured from records of previous troubles and adjustments.

(6) *Intermittent troubles.* Intermittent trouble is the most difficult to trace. Intermittent electrical faults are caused usually by thermal effects; therefore, heating or overheating may be causing a break in the circuit of a component. The fault may be a break which joins when the part cools, but its functional heat ruptures the loose joint and stops the operation of the recorder. The fault also may be a short circuit within the part which occurs when heat expansion brings two elements of the part together and allows them to separate when the part cools. Either of these effects may be found in defective vacuum tubes, wire wound resistors, chokes, and transformers. A charred appearance and characteristic odor will identify a resistor which has been damaged by overheating. Hermetically sealed transformers and chokes are not easily proved to be defective. Sometimes it is possible to trace the trouble to a transformer or choke only by proving that all other parts are good. Test vacuum tubes for intermittent trouble by substituting tubes that are known to be good for the suspected tubes. Allow the unit to remain on test long enough to make sure that the tubes actually were defective. It is not enough, however, to replace a part damaged by overheating. The cause of the trouble must be established so that the replacement part will not be damaged or destroyed. Examine the wiring as well as connected parts until the cause of the trouble is established and corrected.

(7) *Diminished performance.* Diminished performance usually is caused by the gradual failure of a part with limited life expectancy, such as a tube or an electrolytic capacitor. Use a tube tester to test the transconductance of tubes. The actual performance of the unit, however, is the final test of a tube.

(8) *Total failure.* Total failure requires a systematic check of the unit, usually beginning with the power supply. Checks for voltage and resistance readings in vacuum tube circuits always should be made across points which in

themselves have the lowest possible internal resistance.

b. Testing Faulty Equipment. When testing a faulty recorder, test immediately to determine whether the fault is caused by an open in the load circuit. The overload placed on the power stage by an open in the load circuit is particularly severe, due to the square-wave characteristic of the output of the power stage. Operating the amplifier for a few minutes with no load may puncture the insulation between windings of the output transformer and may cause arcing in the power tube. Disconnect the recording coil from the amplifier output on terminal board E2 and test the recording coil with an ohmmeter. The resistance of the recording coil should be approximately 3 ohms.

37. Test Setups for Localizing Troubles

a. Trouble in Recorder or Signal Source.

(1) Connect a source of tone to the TONE terminals of the recorder.

(2) Provide a method of keying the tone source.

(3) Operate the AC switch to the ON position.

(4) Operate the OPERATE-STANDBY switch to the STANDBY position.

(5) Thread the tape and start the flow of ink.

(6) Operate the key. If no signals are recorded on the tape, the trouble is in the recorder or the tone source.

(7) Disconnect the tone source from the recorder and place a headset across the output terminals of the tone source. If no tone is heard, the trouble is in the tone source. If tone is heard, the trouble is in the recorder.

b. Trouble in Power Amplifier or Preceding Stages.

(1) Connect a key to the CONTACT and GROUND terminals on the rear of the recorder.

(2) Operate the key. If no signal is recorded on the tape, the trouble is in the power amplifier stage. If signals are recorded on the tape, the trouble is in the preceding stages.

c. Trouble in Voltage Amplifier Stage.

(1) Connect a lead from the positive (+) end of a standard 4½ volt battery to the GROUND terminal on the rear of the recorder.

(2) Connect a lead to the negative (—) end of the battery.

(3) Using the lead from the negative (—) end of the battery, make and break contact to the F SHIFT terminal on the rear of the recorder. If no signal is recorded on the tape, the trouble is in the voltage amplifier stage. If signals are recorded, the trouble is in the preceding stages.

d. Trouble in Variable Gain Input or Signal Rectifier Stages.

(1) Connect a tone source to the TONE 500 OHMS or 5000 OHMS terminal and the GROUND terminal on the rear of the recorder.

(2) Insert a headset plug into the MONITOR jack. If tone is not heard, the trouble is in the variable gain stage. If tone is heard, the trouble is in the signal rectifier stage.

e. Trouble in Pen Mechanism.

(1) Adjust the PEN POWER control to various settings and check the operation of the pen.

(2) Adjust the SIGNAL LEVEL control to various settings and check the operation of the pen. An irregular or poorly formed ink line is caused by binding in the pen mechanism. If replacement of the pen is necessary, refer to paragraph 12.

38. Troubleshooting Chart

The troubleshooting chart is designed to supplement the operational checks given in paragraphs 27 and 37. If the previous operational checks have resulted in reference to a particular symptom, go directly to the referenced symptom. If no operational symptoms are known, begin with item 1 of the equipment performance check list (par. 27) or follow the procedures given in paragraph 37. After the trouble has been localized, a tube check and voltage and resistance measurements should isolate the defective part.

Symptom	Probable cause	Remedy
1. AMPLIFIER indicator lamp does not light.	1. No ac power.	1. Check power source (item 11, par. 27).
	AMPLIFIER fuse F1 open.	Replace fuse.
	Defective power cord.	Repair or replace power cord.
	Defective receptacle P1.	Replace receptacle.
	AMPLIFIER indicator lamp I 1 defective.	Replace lamp.
	AC switch S5 defective.	Replace switch.
	Switch S4 defective.	Replace switch.
2. AMPLIFIER indicator lamp flashes and AMPLIFIER fuse F1 burns out.	2. Transformer T3 defective.	2. Check and replace transformer if necessary.
	Tube filament shorted.	Check tube filaments and replace defective tube.
	Capacitor C10 shorted.	Replace capacitor.
	Capacitor C11 shorted.	Replace capacitor.
	Capacitor C12 shorted.	Replace capacitor.
3. PULLER indicator lamp does not light.	3. PULLER fuse F2 defective.	3. Replace fuse.
	PULLER indicator lamp I2 defective.	Replace lamp.
	OPERATE-STANDBY switch S2 defective.	Replace switch.
4. PULLER indicator lamp flashes and PULLER fuse F2 burns out.	4. Selenium rectifier CR1 shorted.	4. Replace rectifier.
	Shorted field winding on tape drive motor B1.	Check windings and replace motor if necessary.
	Shorted capacitor C9.	5. Replace capacitor.
5. Tape drive motor does not operate.	5. Open capacitor C9.	5. Replace capacitor.
	Defective SPEED-RANGE switch S6.	Replace switch.
	Open field windings on tape drive motor B1.	Check windings and replace motor if necessary.
6. Friction drive wheel does not contact tape drive motor cone.	6. Defective plug-in electrolytic capacitor C8.	6. Replace capacitor.
	Defective selenium rectifier CR1.	Replace rectifier.
	Defective solenoid L3.	Replace solenoid.
	Mechanical defect in drive motor system.	Check mechanical operation of drive motor system and replace required part.
7. Tape drive roller does not rotate.	7. Worn friction drive wheel.	7. Replace friction drive wheel.
8. Tape tears or breaks between pen and tape platen.	8. Too much pressure between pen and tape platen.	8. Adjust platen lever adjustment (par. 15*h*).
9. Ink does not flow on tape.	9. Too much pressure of tape platen.	9. Adjust platen lever adjustment (par. 16*a*(2)).
	Dirt in inking system or hardening of ink.	Wash inkwell and pen hose with clear water (par. 12*a*).
	Defective inkwell valve control.	Replace inkwell valve control (par. 41*d*).
10. Ink drips on tape.	10. Not enough pressure of tape platen.	10. Adjust platen lever adjustment (par. 16*a*(2)).
11. Ink line irregular or poorly formed.	11. Pen mechanism binding.	11. Loosen right-hand pen bearing lock screw and adjust pen bearing with special bearing tool (fig. 6).
12. Ink line not centered on tape.	12. Centering screws improperly set.	12. Adjust centering screws (par. 42*c*).
13. Signal will not reverse on tape.	13. Defective PEN REVERSE switch S3.	13. Replace switch.

Symptom	Probable cause	Remedy
14. No signal recorded on tape with hand key connected across CONTACT and GROUND terminals.	14. Defective power amplifier tube V4.	14. Replace tube.
	Defective component in power amplifier circuit.	Make voltage and resistance checks (figs. 16 and 17) and replace defective component.
a. No B+ voltage	*a.* Choke L4 open.	*a.* Replace choke.
b. No B+ voltage to tubes V1 and V3.	*b.* Resistor R15 open.	*b.* Replace resistor.
c. No voltage on pin 3 of V4.	*c.* Open primary winding, transformer T2.	*c.* Replace transformer.
d. No voltage on pin 4 of V4.	*d.* Variable resistor R18 open.	*d.* Replace resistor.
	Capacitor C7B shorted.	Replace capacitor.
e. Low voltage on pin 4 of V4.	*e.* Resistor R13, R21, or R20 open.	*e.* Replace resistor.
	Capacitor C7A shorted.	Replace capacitor.
15. No signal recorded on tape with teletypewriter signal connected across F SHIFT and GROUND terminals.	15. Defective voltage amplifier tube V3.	15. Replace tube.
	Defective filter component (coil L1 and capacitor C4).	Check and replace defective component.
	Resistor R8 open.	Replace resistor.
	Defective component in voltage amplifier circuit.	Make voltage and resistance checks and replace defective component.
a. Negative voltage on pin 8 of V3.	*a.* Resistor R11 open.	*a.* Replace resistor.
	Capacitor C5 shorted.	Replace capacitor.
b. No voltage on pin 6 of V3.	*b.* Resistor R10 open (only noticable with FILTER switch S1 operated to IN position).	*b.* Replace resistor.
	Capacitor C3B shorted.	Replace capacitor.
16. No signal recorded on tape with tone signal connected across either TONE terminal and GROUND terminal.	16. Defective signal rectifier tube V2.	16. Replace tube.
	Defective variable gain input tube V1.	Replace tube.
	Defective component in signal rectifier or variable gain input circuit.	Make voltage and resistance checks and replace defective component.
a. No. voltage on pin 8 of V1.	*a.* Open primary winding on transformer T1.	*a.* Replace transformer.
b. No voltage on pin 6 of V1.	*b.* Resistor R6 open.	*b.* Replace resistor.
	Capacitor C3A shorted.	Replace capacitor.
c. High voltage on pin 5 of V1.	*c.* Resistor R3 open (internal resistance of meter acting as cathode bias resistor).	*c.* Replace resistor.
17. No output in headset with tone connected across either TONE terminal and GROUND terminal.	17. Defective MONITOR jack J1.	17. Replace jack.
	Open resistor R4.	Replace resistor.
18. FILTER switch ___ no effect when operated to IN position.	18. Defective FILTER switch S1.	18. Replace switch.
	Open capacitor C5.	Replace capacitor.
19. PEN POWER control ___ no effect on inked signal line.	19. Defective variable resistor R18.	19. Check and replace resistor.
20. SIGNAL LEVEL control ___ no effect on inked signal line.	20. Defective variable resistor R9.	20. Check and replace resistor.

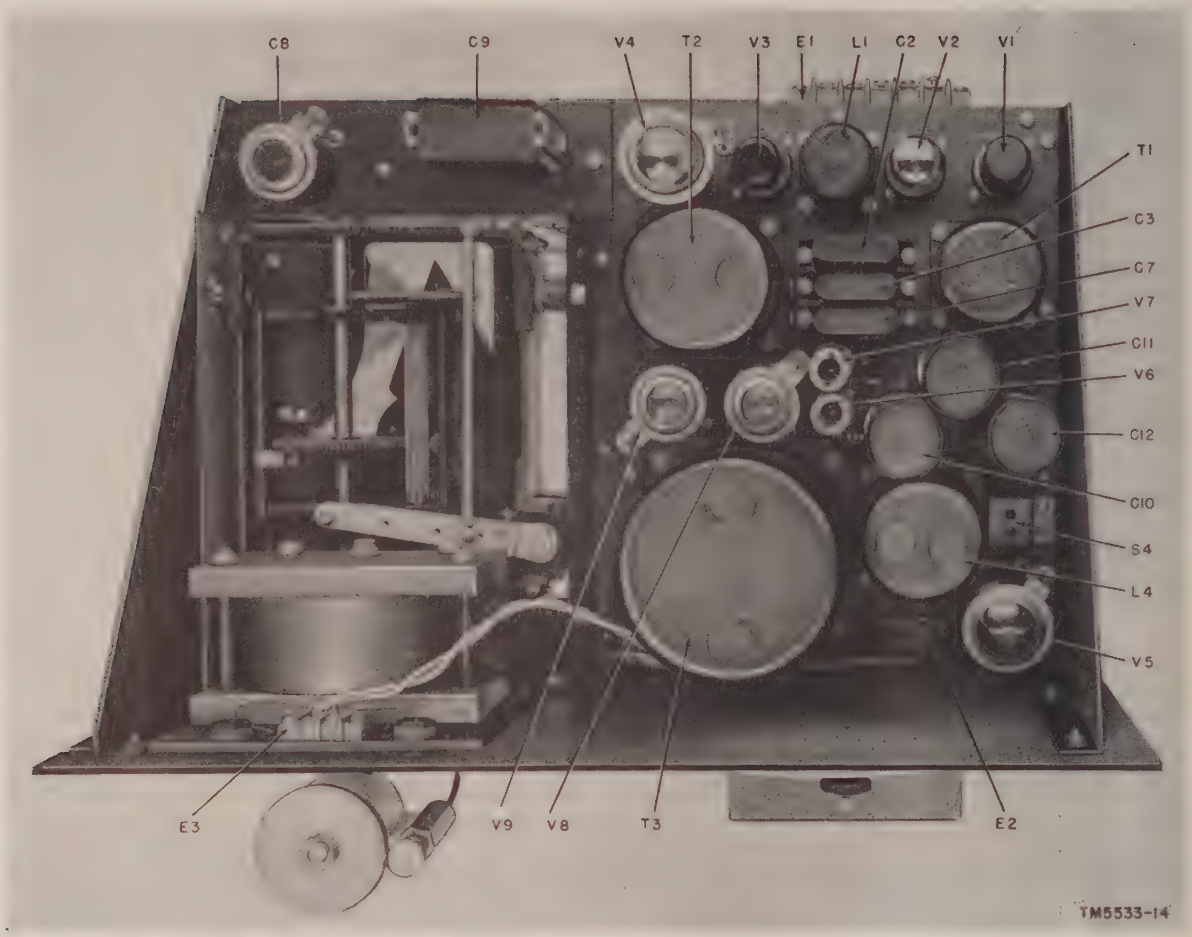


Figure 14. Top view, location of parts.

39. Troubleshooting with Oscilloscope (figs. 12 and 22)

Supply the recorder with a repeated signal transmitted from a keyer running at maximum speed. Make a stage-by-stage analysis of the keying envelope; follow the procedure outlined below.

Note. Both the leading and trailing edges of the keying envelope must be preserved and should be reasonably square and not distorted. If the keying envelope is distorted in any way, the recorder will not function properly.

a. Variable Gain Input Stage.

(1) Examine the keying envelope being developed by the keyer.

(2) Examine the keying envelope on the plate of tube V1. The appearance of the keying envelope on the plate of tube V1 should be comparable to the keying envelope obtained from the keyer.

(3) Check the keying envelope for steep leading and trailing edges. If the keying envelope does not have steep leading and trailing edges, the low- or high-frequency response is incorrect.

(*a*) Check the resistance in both the primary and secondary circuits of transformer T1.

(*b*) Examine the wave form across the primary winding and both halves of the secondary winding of transformer T1, which must show equal signal output, opposing in phase.

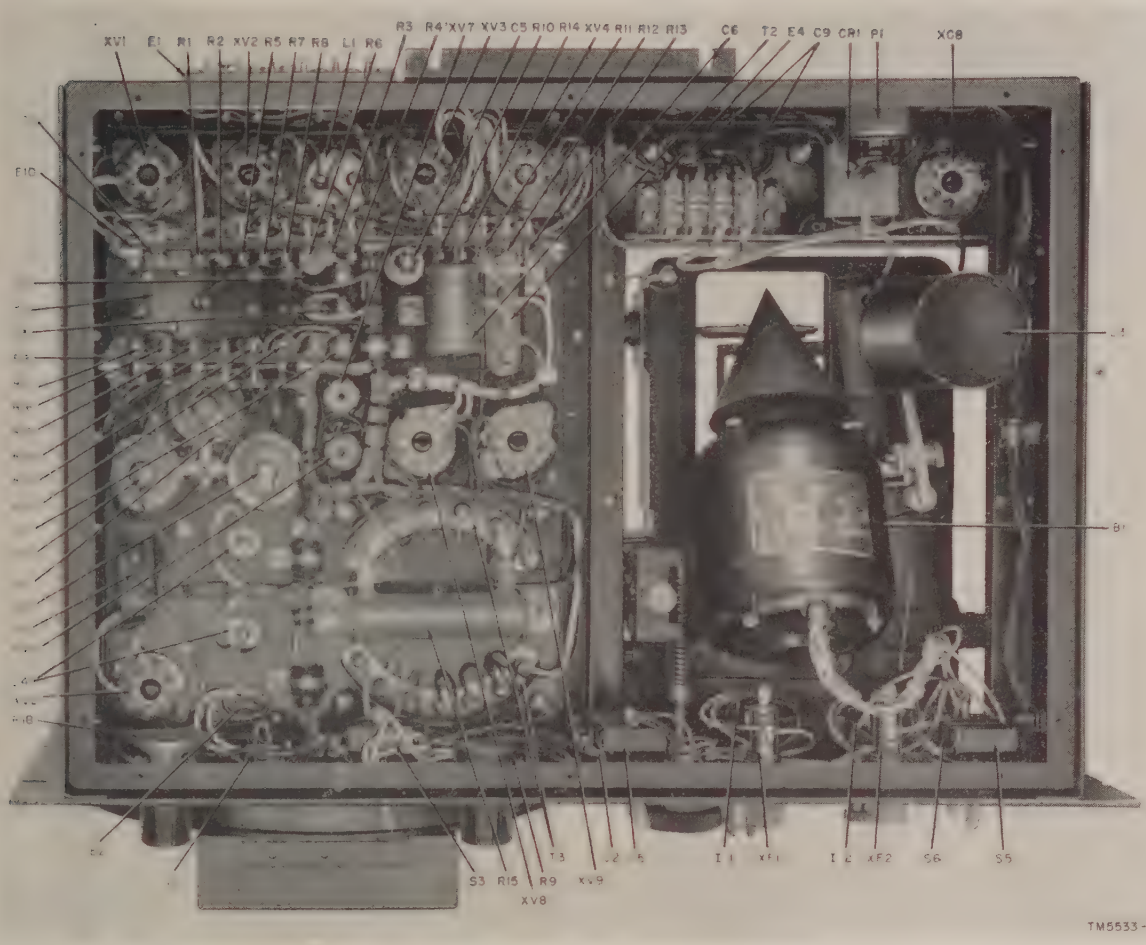


Figure 15. Bottom view, location of parts.

b. Signal Rectifier Stage.

(1) Examine the wave forms on the cathodes of tube V2.

(2) Examine the wave form on the plates of tube V2. If tube V2 is not providing full-wave rectification of the signal, the front of the keying envelope will be deformed.

(3) Examine the wave form across resistor R9.

Note. Breakdown in the filter (composed of capacitor C4 and coil L1) will cause the keying envelope to be filled with ac ripple.

c. Voltage Amplifier Stage.

(1) Examine the keying envelope on the control grid of tube V3.

(2) Examine the keying envelope on the plate of tube V3. The keying envelope should be free of all ac ripple and comparable to a rectangular wave.

d. Power Amplifier Stage.

(1) Examine the keying envelope on the control grid of tube V4.

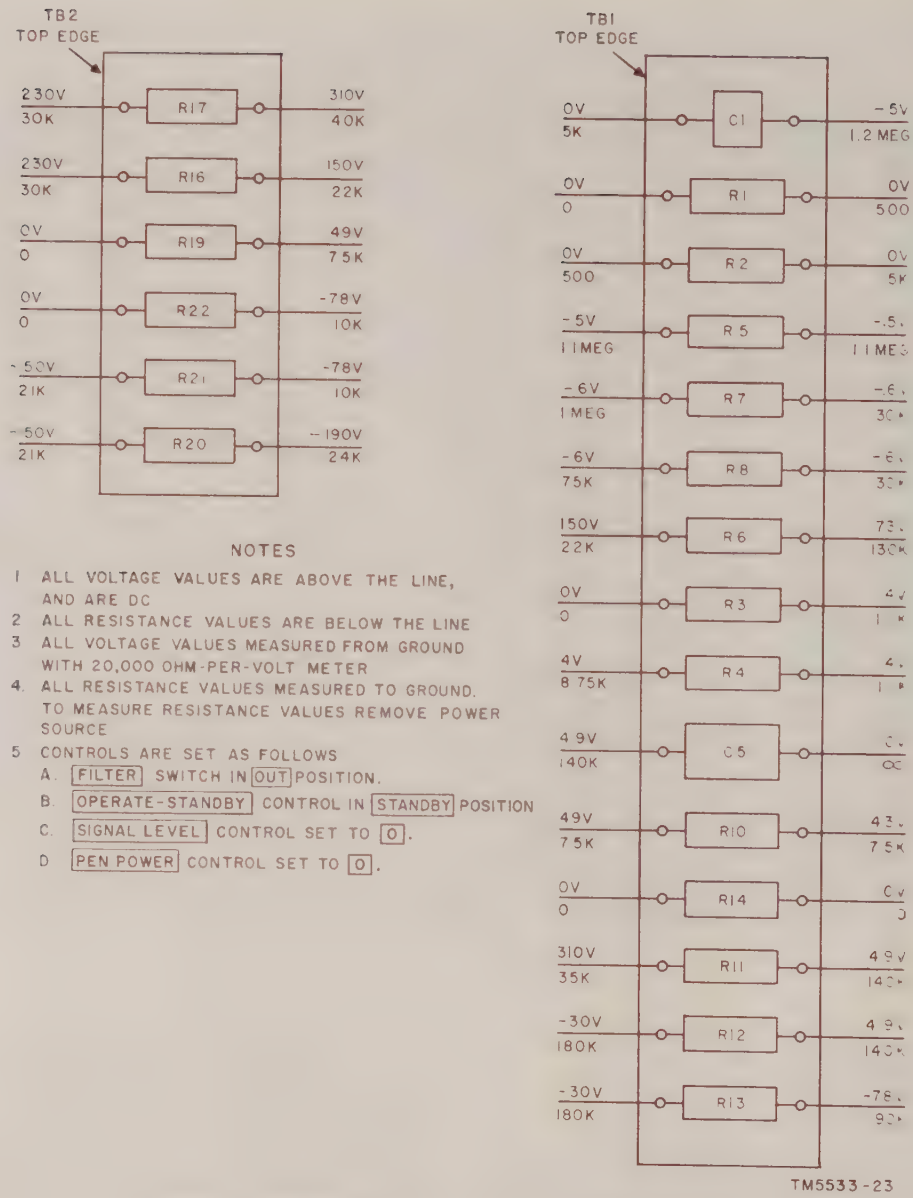
(2) Examine the keying envelope on the plate of tube V4. The keying envelope should show a large increase in amplitude, with no distortion of the square wave.

e. Output Transformer.

(1) Examine the power peaks in the secondary winding of transformer T2.

(2) Check the power peaks for steep fronts and rapid decay.

Note. If the leading edges of the power peaks are reduced, the recording coil will not have sufficient drive to draw the pen

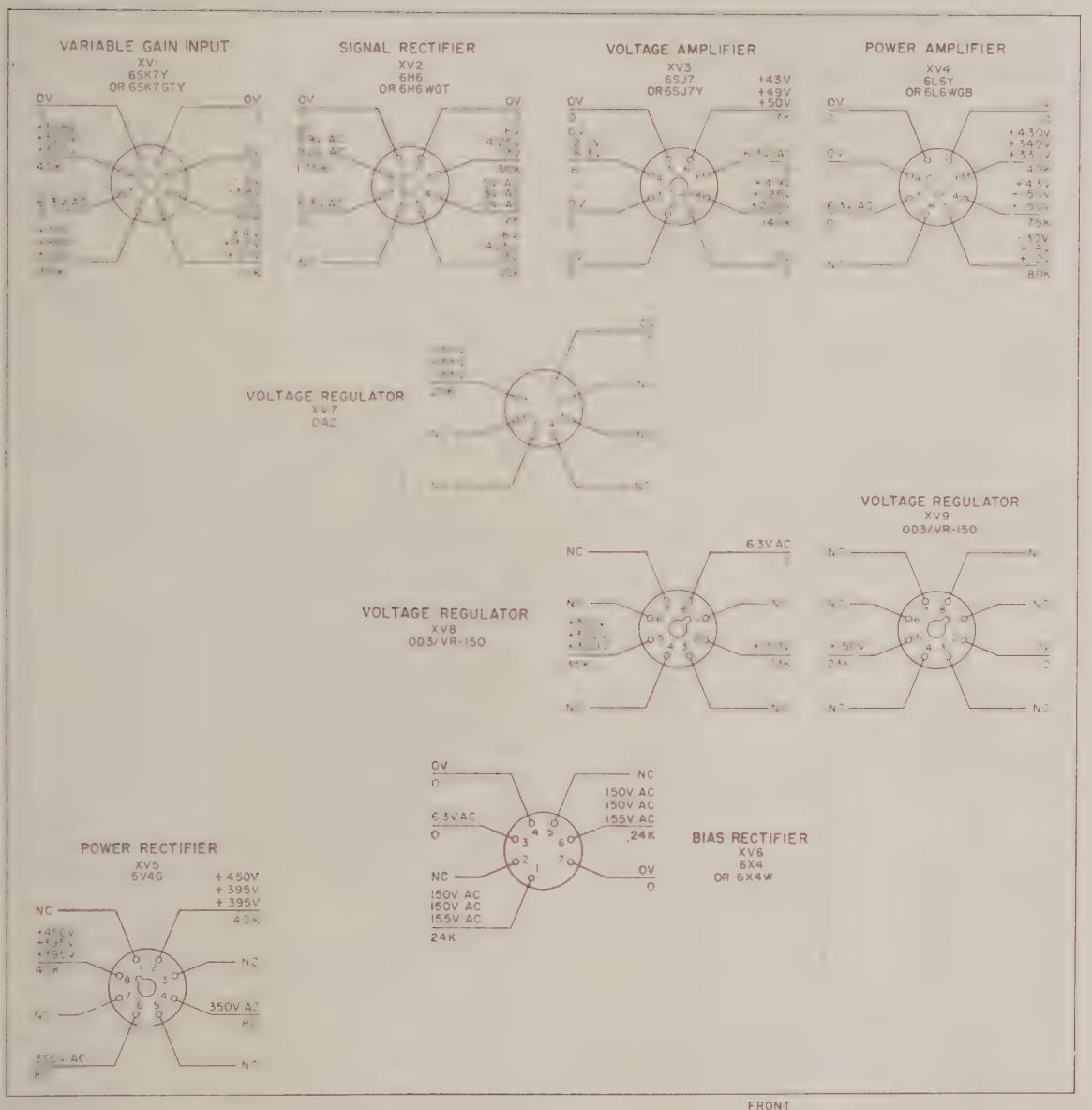


NOTES

1. ALL VOLTAGE VALUES ARE ABOVE THE LINE, AND ARE DC
2. ALL RESISTANCE VALUES ARE BELOW THE LINE
3. ALL VOLTAGE VALUES MEASURED FROM GROUND WITH 20,000 OHM-PER-VOLT METER
4. ALL RESISTANCE VALUES MEASURED TO GROUND. TO MEASURE RESISTANCE VALUES REMOVE POWER SOURCE
5. CONTROLS ARE SET AS FOLLOWS
   - A. [FILTER] SWITCH IN [OUT] POSITION.
   - B. [OPERATE-STANDBY] CONTROL IN [STANDBY] POSITION
   - C. [SIGNAL LEVEL] CONTROL SET TO [0].
   - D [PEN POWER] CONTROL SET TO [0].

Figure 16. Terminal boards voltage and resistance diagram.

from side to side. If the peaks do not decay rapidly enough, too much current will flow through the recording coil and cause overheating. If the power peaks decay too rapidly, the pen will be drawn away from the side to which it was driven.



NOTES.

1. ALL VOLTAGES MEASURED FROM GROUND WITH 20,000 OHMS-PER-VOLT METER
2. ALL VOLTAGE VALUES ARE ABOVE THE LINE AND ARE DC UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTANCE VALUES ARE BELOW THE LINE. TO MEASURE RESISTANCE VALUES REMOVE POWER SOURCE
4. NC = NO CONNECTION.
5. IF THREE VOLTAGES ARE GIVEN, THEY ARE OBTAINED AS FOLLOWS

VOLTAGE	INPUT SIGNAL	CONNECTION	SIGNAL LEVEL CONTROL	PEN POWER CONTROL	FILTER SWITCH
TOP	ZERO	NONE	0	MINIMUM	OUT
CENTER	1 VOLT AT 1,000 CPS	500 OHMS	5	MAXIMUM	OUT
LOWER	5 VOLTS AT 1,000 CPS	5,000 OHMS	5	MAXIMUM	OUT

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Figure 17. Tube sockets voltage and resistance diagram.

40. General Repair Instructions

a. Most of the components of the RD–60/U can be reached and can be replaced easily by using common hand tools.

b. If a component, such as a switch, transformer, or motor, requires replacement, carefully mark and tag the wires to avoid wiring errors.

41. Removal of Parts

a. Removal of Recording Mechanism.

(1) Remove the inkwell; follow the procedure outlined in paragraph 12*a*(1) through (3).

(2) Disconnect the four leads from terminal board E3 (fig. 14).

(3) Remove the fillister-head assembly mounting screws (15, fig. 18) that hold the recording mechanism to the recorder front panel.

(4) Remove the recording mechanism from the recorder.

b. Disassembly of Pen Assembly (fig. 18).

(1) Remove the fillister-head pen block mounting screws (1) that hold the pen block (2) to the surface plate (3).

(2) Remove the fillister-head mounting screws (4) that hold the pen and yoke assembly mounting plate (5) to the surface plate (3).

(3) Slide the pen and yoke assembly (8 and 9) to the left and remove it.

(4) Loosen the fillister-head pen bearing lock screws (6).

(5) Remove the plastic right hand pen bearing (7) with the special bearing tool (fig. 6).

(6) Remove the pen (8) from the pen yoke (9).

(7) Loosen the fillister-head lock screws (10) that hold the steel yoke bearings (11).

(8) Loosen the steel yoke bearings (11).

(9) Remove the center centering screw (12) from the pen and yoke assembly mounting plate (5) and remove the pen yoke (9).

(10) Remove the fillister-head mounting screws (13) that hold the inkwell mounting bracket (14) to the surface plate (3), and remove the inkwell mounting bracket.

c. Disassembly of Recording Mechanism.

(1) Remove the oval-head mounting screws (16), and remove the surface plate (3).

(2) Remove the binder-head mounting screws (17) that hold the magnetic slot plate (18) to the end plate (19).

(3) Remove the magnetic slot plate (18).

Note. The magnetic slot plate is held fast by the permanent magnet field, and requires force for removal.

(4) Remove the fillister-head mounting screws (20) that hold the pivot bearing bracket (21) to the end plate (19).

Caution: Do not attempt to remove the top and bottom plates from the magnet. The plates never require removal, and can be separated only by sledge hammer blows. If the plates are removed, the magnet will lose approximately 70 percent of its effectiveness.

(5) Remove the pivot bearing bracket (21) and the attached reproducer-head recording coil (22).

(6) Loosen the fillister-head lock screws (23) that hold the plastic pivot bearings (24).

(7) Loosen the plastic pivot bearings (24) and remove the recording coil pivot (25).

(8) Remove the bakelite bearing (26) that fits into the recording coil sleeve (27).

d. Disassembly of Ink Valve Assembly (fig. 19).

(1) Remove the inkwell; follow the procedure outlined in paragraph 12*a*(1) through (3).

(2) Use a wrench to loosen the check nut from the cylinder.

(3) Unscrew the valve body from the inkwell cylinder on the side of the inkwell. Do not lose the rubber washer at the base of the cylinder; the washer must be used when replacing the ink valve assembly.

(4) Unscrew the inkwell valve control until the needle assembly is removed from the valve body.

Caution: The needle will spring out of the valve body due to the retainer spring. Keep a firm grip on the inkwell valve control to prevent the spring from forcing the needle from the valve body. If the needle is dropped and bent, the inking system will not function properly.

42. Replacement of Parts and Adjustments

a. Assembling Recording Mechanism (fig. 18).

(1) Insert the bakelite bearing (26) into the recording coil sleeve (27).

(2) Insert the recording coil pivot (25) into the pivot bearing bracket (21).

(3) Tighten the plastic pivot bearings (24) until the recording coil pivot (25) does not move from side to side.

(4) Tighten the fillister-head lock screws (23) that hold the plastic pivot bearings (24).

Caution: Avoid overtightening the lock screws to prevent damaging the bakelite bearings.

(5) Place the pivot bearing bracket (21) and the attached reproducer-head recording coil (22) on the end plate (19), with the recording coil (22) over the magnetic pole piece (28).

(6) Insert the fillister-head mounting screws (20) into the holes provided on the pivot bearing bracket (21), and tighten the mounting screws in the mounting holes (29) provided on the end plate (19).

Note. The reproducer-head recording coil (22) should have no side-to-side movement, but should move freely up and down approximately ¼ inch over the magnetic pole piece. Be sure that the coil does not scrape the pole piece.

(7) Place the magnetic slot plate (18) over the magnetic blade (30), and line up the mounting holes (31) with the magnetic slot plate (18). The longest side of the slot in the magnetic slot plate (18) should be facing the end plate when installed.

(8) Tighten the binder-head mounting screws (17) in the mounting holes (31). The magnetic blade (30) should move freely up and down within the slot in the magnetic slot plate (18).

(9) Place the surface plate (3) over the end plate (19).

(10) Line up the mounting holes (33) on the surface plate (3) with the mounting holes (32) on the end plate (19).

(11) Replace the oval-head mounting screws (16) into the mounting holes (32 and 33).

(12) Connect the recording coil leads to terminal board E3.

(13) Place the inkwell mounting bracket (14) on the surface plate (3).

(14) Line up the mounting holes of the inkwell mounting bracket with the mounting holes (34) on the surface plate (3).

(15) Replace the fillister-head mounting screws (13) into the mounting holes (34).

(16) Insert the pen (8) into the holes on the pen yoke (9). Be sure the pen is clean before installing.

(17) Place the plastic right hand pen bearing (7) over the stem of the pen (8).

(18) Use the special bearing tool and tighten the right hand pen bearing. It may be necessary to adjust both pen bearings (7). The pen should have no side-to-side movement but should move freely in its normal excursion.

(19) Tighten the fillister-head pen bearing lock screws (6).

Caution: Avoid overtightening the lock screws to prevent damaging the bakelite bearings.

(20) Place the pen yoke (9) over the pen

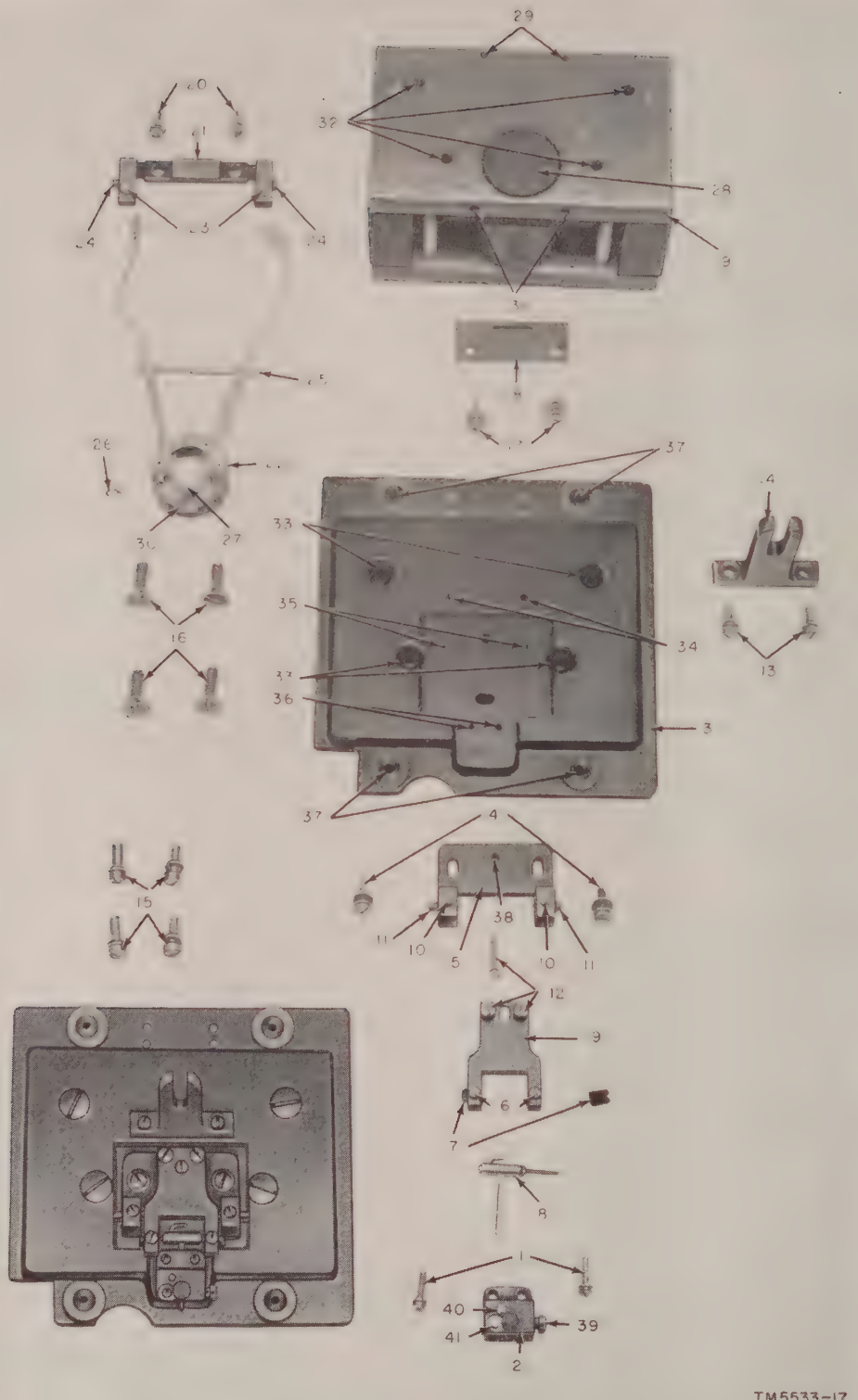


Figure 18. Recording mechanism and pen and yoke assembly, assembled and disassembled.

1 Pen block mounting screw; fillister-head, #6–32 NC–2 by ½ inch long.
2 Pen block.
3 Surface plate.
4 Mounting screws; fillister-head, #6–32 NC–2 by ⅜ inch long.
5 Pen and yoke assembly mounting plate.
6 Pen bearing lock screws; fillister-head, #4–40 NC–2 by $\frac{3}{16}$ inch long.
7 Right hand pen bearings; plastic, #10–32 by $\frac{3}{32}$ inch ID, ¼ inch OD by $\frac{7}{16}$ inch long.
8 Pen; .025 inch wide line; 1.41 inch long, or .050 inch wide line; 1.41 inch long, or .015 inch wide line; 1.41 inch long.
9 Pen yoke.
10 Lock screws; fillister-head, #4–40 NC–2 by ¼ inch long.
11 Yoke bearings; steel (cone point), #10–32 by ½ inch long.
12 Centering screws; one fillister-head, #6–32 NC–2 by ¾ inch long, or two fillister-head, #6–32 NC–2 by ⅝ inch long.
13 Mounting screws; fillister-head, #10–32 NF–2 by ⅜ inch long.
14 Inkwell mounting bracket.
15 Assembly mounting screws; fillister-head, #10–32 NF–2 by ⅜ inch long.
16 Mounting screws; oval-head, #¼–20 NC–2 by ¾ inch long.
17 Mounting screws; binder-head, #8–32 NC–2 by ½ inch long.
18 Magnetic slot plate.
19 End plate.
20 Mounting screws; fillister-head, #6–32 NC–2 by ½ inch long.
21 Pivot bearing bracket.
22 Recording coil; reproducer-head, 1.345 inch diameter by $1\frac{1}{4}$ inch long overall.
23 Lock screws; fillister-head, #4–40 NC–2 by ¼ inch long.
24 Pivot bearings; plastic, #10–32 by ⅜ inch long.
25 Recording coil pivot (part of recording coil).
26 Bakelite bearing; ⅛ inch OD, $\frac{3}{32}$ inch ID, $\frac{5}{16}$ inch long.
27 Recording coil sleeve (part of recording coil).
28 Magnetic pole piece.
29 Mounting holes; #6–32 NC thread.
30 Magnetic blade (part of recording coil).
31 Mounting holes; #8–32 NC thread.
32 Mounting holes; #¼–20 NC thread.
33 Mounting holes; ¼ dia, no thread.
34 Mounting holes; #6–32 NC thread.
35 Mounting holes; #6–32 NC thread.
36 Mounting holes; #6–32 NC thread.
37 Mounting holes; #10–32 NF thread.
38 Centering screw mounting hole; #6–32 NC thread.
39 Lock screws; fillister-head, #6–32 NC–2 by ⅜ inch long.
40 Mark excursion adjustment (part of pen block, not removable).
41 Space excursion adjustment (part of pen block, not removable).

Figure 18—Continued.

and yoke assembly mounting plate (5).

(21) Tighten the steel yoke bearings (11) and tighten the fillister-head lock screws (10).

(22) Place the center centering screw (12) into the hole on the pen yoke (9) and into the centering screw mounting hole (38).

(23) Line up the holes in the yoke mounting plate (5) with the mounting holes (35) on the surface plate (3).

(24) Replace the fillister-head mounting screws (4) into the mounting holes (35).

(25) Line up the holes of the pen block (2) with the mounting holes (36) of the surface plate (3).

(26) Replace the fillister-head pen block mounting screws (1) into the mounting holes (36).

(27) Place the recording mechanism inside the recorder and connect the leads from terminal board E2 to terminal board E3.

(28) Line up the mounting holes (37) on the surface plate (3) with the holes on the front panel of the recorder.

(29) Replace the fillister-head assembly mounting screws (15) into the mounting holes (37) on the surface plate (3).

b. Assembling Ink Valve Assembly (fig. 19).

(1) Insert and thread the valve body into the inkwell cylinder on the side of the inkwell.

(2) Finger tighten the valve body.

(3) Tighten the check nut on the cylinder with a wrench.

(4) Place the retainer spring over the needle assembly.

(5) Insert the needle assembly and retainer spring into the valve body.

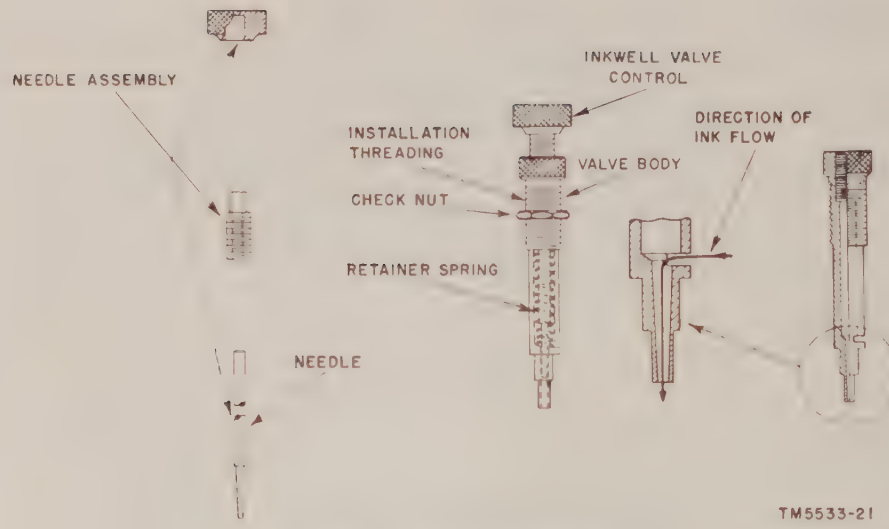


Figure 19. Ink valve assembly.

(6) Thread the needle assembly into the valve body and tighten with finger pressure.

c. Pen Centering (fig. 6).

(1) Loosen the two outside centering screws.

(2) Adjust the center centering screw until the ink line is drawn down the center of the paper tape. If the ink line is off-center toward the panel of the recorder, turn the center screw clockwise. If the ink line is off-center away from the panel of the recorder, turn the center screw counterclockwise.

(3) Tighten the two outside centering screws.

d. Adjusting Pen Excursion (fig. 18).

(1) Loosen the fillister-head lock screws (39) on the pen block (2).

(2) Turn the mark excursion adjustment (40) clockwise.

(3) Turn the space excursion adjustment (41) counterclockwise. With the recorder and a keyer running at maximum speed, a high-pitched, whipping sound should be noticeable from the stroke of the pen. The excursion of the pen is limited to the travel of the magnetic blade (30) of the recording coil within the slot of the magnetic slot plate (18).

(4) Turn the mark excursion adjustment (40) counterclockwise to limit the excursion of the pen to the space position. When the excursion adjustments have been made, the stroke of the pen will sound heavier as compared to the high-pitched, whipping sound previously heard.

(5) Tighten the fillister-head lock screws (39). The excursion of the pen must be adjusted properly to prevent splattering of ink during high speed operation.

e. Replacing Tape Drive Motor (fig. 13).

(1) Remove the electrical connections to the motor. The wires are color-coded and the connections are indicated on the wiring diagram (fig. 23).

(2) Remove the pivot screw and motor mounting screws.

Caution: Do not tamper with the fitting of the tape drive motor cone to the shaft. Fitting tolerances are close, and tampering can result in damage to the equipment.

(3) Mount the new motor and gently tighten the pivot screw and adjusting screws.

(4) Make the electrical connections to the motor (fig. 22).

(5) Lift the end of the speed control arm until the pivot stud at the end of the speed control arm clears the slot in the drive frame.

(6) Check to see that the drive frame slides freely on the drive shaft.

(7) Apply power to the recorder and operate the AC switch to the ON position.

(8) Operate the OPERATE-STANDBY switch to the OPERATE position.

(9) Check to see that the solenoid draws the drive frame down until contact is made between the friction drive wheel and tape drive motor cone. If the motor is out of alignment because of the adjustment of the pivot and adjusting screws, the friction drive wheel will creep along the cone and carry the drive frame with it. Turn the tape drive motor on the axis of the pivot screw until the friction drive wheel rotates in contact with the cone without creeping.

(10) Operate the OPERATE-STANDBY switch to the STANDBY position.

(11) Lift the end of the speed control arm and insert the pivot stud at the end of the arm into the slot provided on the drive frame.

(12) Tighten the pivot and adjusting screws.

(13) Operate the OPERATE-STANDBY switch to the OPERATE position.

(14) Loosen the lock screws on the speed control arm, and set the SPEED CONTROL FEET PER MINUTE to maximum.

(15) Adjust the set screw in the speed control arm for the maximum speed stop until the friction drive wheel reaches the skirt of the tape drive motor cone.

(16) Set the SPEED CONTROL FEET PER MINUTE to minimum.

(17) Adjust the set screw in the speed control arm for the minimum speed stop until the friction drive wheel reaches the tip of the tape drive motor cone.

Caution: Do not allow the friction drive wheel to go over these limits or the drive assembly will be damaged during operation.

(18) Tighten the lockscrews on the speed control arm.

f. Replacing Friction Drive Wheel (fig. 13).

(1) Remove the screws that hold the friction drive wheel to the drive gear.

(2) Slide the friction drive wheel from the shaft of the drive gear.

Note. The composition rim and flange of the friction drive wheel are fabricated together and cannot be separated.

(3) Slide the new friction drive wheel (obtained from the special tool kit) on the shaft of the drive gear.

(4) Replace and tighten the screws that hold the friction drive wheel to the drive gear.

g. Replacing Solenoid and Plunger (fig. 13).

(1) Remove the leads from terminal board E4 that connect to the solenoid (fig. 15).

(2) Remove the screws that hold the solenoid to the drive assembly mounting.

(3) Slide the solenoid straight out from the mounting. The plunger is loosely centered in the solenoid with no mechanical connection.

(4) Remove and replace the plunger.

(5) Slide the new solenoid over the plunger.

(6) Tighten the mounting screws that hold the solenoid to the drive assembly mounting.

(7) Replace the leads to terminal board E4 from the solenoid.

h. Replacing Tape Drive Assembly.

(1) Remove the braided wire connection between the casting and the chassis (fig. 13).

(2) Remove the motor and solenoid connections.

(3) Remove the screws on the SPEED CONTROL FEET PER MINUTE knob, and slide off the top cap (fig. 5).

(4) Use the No. 6 Allen wrench and loosen the set screws on the remaining section

of the SPEED CONTROL FEET PER MINUTE knob.

(5) Remove the SPEED CONTROL FEET PER MINUTE knob from the shaft.

(6) Use the No. 8 Allen wrench and loosen the set screw on the tape drive roller (fig. 7).

(7) Remove the tape drive roller from the shaft.

(8) Use the No. 10 Allen wrench and loosen the set screw on the tape platen lever.

(9) Remove the tape platen lever from the shaft.

(10) Remove the assembly mounting screws (15, fig. 19).

Note. Rubber grommets are placed between the tape drive assembly mounting and the chassis of the recorder. Do not lose the rubber grommets; they must be used when replacing the tape drive assembly.

(11) Loosen the lock screws that hold the drive shaft and friction drive wheel (fig. 13) in the mounting.

(12) Push the drive shaft to the rear of the mounting and remove it.

(13) Remove the ball bearings, and replace if necessary.

(14) Remove the screws that hold the drive gear to the shaft.

(15) Loosen the lock screws that hold the drive gear shaft in the mounting.

(16) Move the drive gear shaft forward and out of the rear bearing.

(17) Lift the end of the drive gear shaft and slide it backward to remove.

(18) Remove the ball bearings, and replace if necessary.

(19) Place the front end of the shaft through the ball bearing and slide it forward.

(20) Lower the back end of the shaft and move the shaft back into the rear ball bearing.

(21) Tighten the screws that hold the drive gear to the shaft.

(22) Tighten the lock screws that hold the ball bearings in place.

(23) Replace the drive shaft and friction drive wheel into the mounting.

(24) Tighten the lock screws that hold the ball bearings in place.

(25) Lift the end of the speed control arm and insert the pivot stud at the end of the arm into the slot on the frame of the drive gear and pinion.

(26) Replace and tighten the assembly mounting screws.

(27) Place the tape platen lever on the shaft, and tighten the set screw with the No. 10 Allen wrench.

(28) Place the tape drive roller on the shaft and tighten the set screw with the No. 8 Allen wrench.

(29) Place the inside section of the SPEED CONTROL FEET PER MINUTE knob on the shaft, and tighten the set screws with the No. 6 Allen wrench.

(30) Place the top cap of the SPEED CONTROL FEET PER MINUTE knob on the shaft, and tighten the set screws.

Note. Before tightening the set screws of the SPEED CONTROL FEET PER MINUTE knob, set the dial to correspond to the setting of the friction drive wheel.

Section IV. FINAL TESTING

43. Purpose

Equipment which has been repaired must meet definite minimum performance standards before it is returned to service. The tests outlined in this section are designed to measure the performance capability of a repaired RD–60/U. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation.

44. Test Equipment Required

The test equipment required for final testing is the same as that listed for troubleshooting (par. 35). Refer to the appropriate technical manuals for instructions on the use of the test equipment.

45. Tests

a. Testing with Audio Oscillator and Hand Key.

(1) Connect the RD–60/U to a power source and operate the AC switch to the ON position.

(2) Thread the tape through the tape drive assembly (fig. 7).

(3) Apply a 1,000-cps signal across the TONE 500 OHMS and GROUND terminals on the rear of the recorder chassis through the hand key.

(4) Adjust the voltage from the signal generator to .75 volt.

(5) Operate the OPERATE-STANDBY switch to the OPERATE position.

(6) Adjust the SIGNAL LEVEL control to the approximate center of its range.

(7) Operate the hand key, and check to see that the pen follows the operation of the key.

(8) Raise the signal voltage to 25 volts. The pen should follow the operation of the key for a weak signal as well as a strong signal.

(9) Apply the 1,000-cps signal across the TONE 5000 OHMS and GROUND terminals on the rear of the chassis through the hand key.

(10) Operate the hand key with the signal voltage set at 1.5 volts; slowly increase the signal voltage to 50 volts. The pen should follow the operation of the key with the signal voltage at any setting from 1.5 to 50 volts.

(11) Set the frequency of the signal generator to 100 cps.

(12) Listen for any indication that the pen is skipping or fluttering while the hand key is operated.

Note. This test approximates a 400-word-per-minute transmission, and the pen should operate with good uniformity with the SIGNAL LEVEL control set to the approximate center of its range.

(13) Set the frequency of the signal generator to 550 cps to check for the frequency above which the pen follows keying instead of applied audio tone.

(14) Apply the signal across the TONE 500 OHMS input and GROUND terminals on the rear of the chassis.

(15) Adjust the input signal to 1 volt.

(16) Vary the PEN POWER control between 0 and 5, and check to see that the recording coil does not buzz.

Note. The initial application of the signal will drive the pen to the mark position unless the pen is already there when the test begins. No other indication will be given by the recording mechanism.

(17) Apply the 550-cps signal across the TONE 5000 OHMS input and GROUND terminals on the rear of the recorder.

(18) Adjust the input signal to 1 volt.

(19) Vary the PEN POWER control between 0 and 5, and check to see that the recording coil does not buzz.

b. Tape Drive Test.

(1) Apply power to the recorder and operate the AC switch to the ON position.

(2) Thread the tape through the tape drive assembly.

(3) Operate the SPEED RANGE switch to the LOW position.

(4) Adjust the SPEED CONTROL FEET PER MINUTE to 30.

(5) Operate the OPERATE-STANDBY switch to the OPERATE position. The tape drive assembly must pass 10 feet of tape in 20 seconds, ± 1 second.

(6) Operate the SPEED RANGE switch to the HIGH position.

(7) Adjust the SPEED CONTROL FEET PER MINUTE to 60. The tape drive assembly must pass 10 feet of tape in 10 seconds, ± 1 second.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

46. Preparation for Shipment

a. Disconnect the recorder from the power source.

b. Remove all connecting wiring from equipment terminals.

c. Empty the inkwell and wash out the inkwell assembly, the ink hose, and pen.

d. Clamp the tape drive mechanism in place with the shipping clamp (fig. 3).

47. Repackaging for Shipment or Limited Storage

a. General. The original packaging materials (fig. 2) may be used to repack the equipment; adapt the procedures given in paragraph 8. Use the cotton twine to tie the power cord; use enough wadding to lessen the effects of severe jarring.

b. Material Requirements. The following materials are required for packaging Code Recorder RD–60/U. The inside dimensions for the wooden box are 27-inches long by 18-inches wide by 15-inches deep.

Material	Quantity
Cotton twine	1 ft
Corrugated fiberboard	36 sq ft
Gummed paper tape	3 ft
Moistureproof barrier	24 sq ft
Pressure-sensitive tape	19 ft
Steel strapping*	13 ft
Wooden shipping box:	1 ea
Board feet	18

* Steel strapping is used for export shipment only.

48. Methods of Destruction

The following demolition procedure will be used to prevent the enemy from using or salvaging this equipment and will be accomplished only upon the order of the commander.

a. Smash. Smash switches, jack, and control knobs, control panel, case, vacuum tubes, tube sockets, transformers, rectifiers, solenoid, connector, plug, terminal boards, fuses, motor, drive cone and disk, gears and shafts, ink reservoir, and reels; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut power cord, wiring, and rubber hose; use handaxes, axes, or machetes.

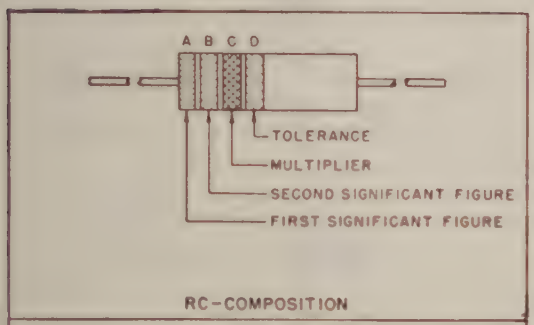
c. Burn. Burn transcribed tapes, blank tape, Signal Corps forms, officer records, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Explode. If explosives are necessary, use firearms, grenades, or TNT.

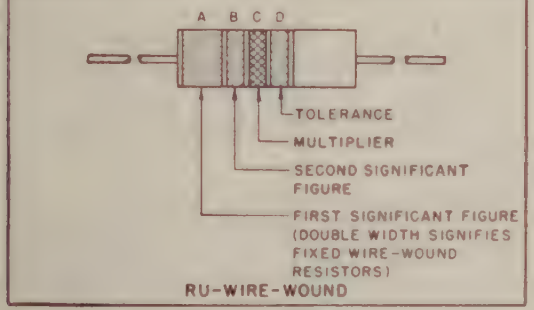
e. Dispose. Bury the destroyed parts in slit trenches, foxholes, or throw them into streams.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

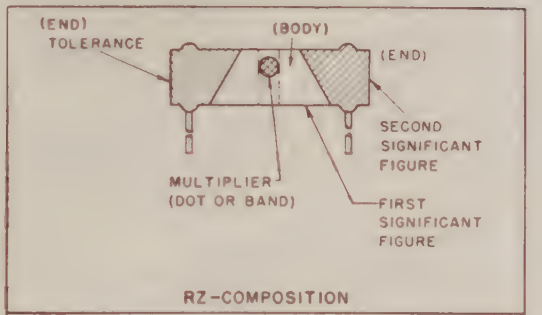


RC-COMPOSITION

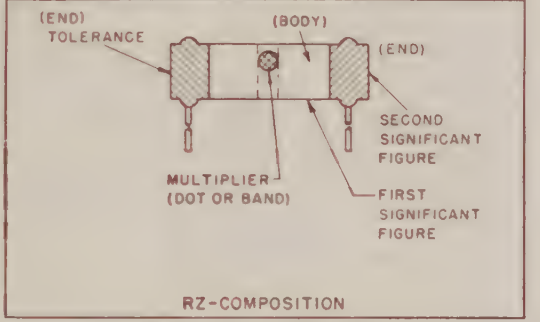


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

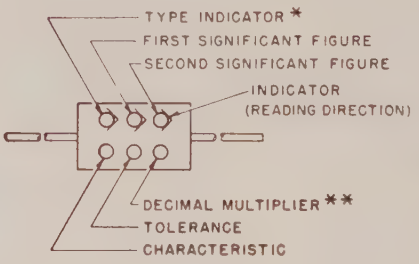
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

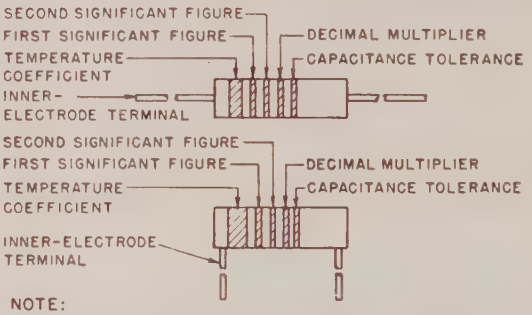
Figure 20. MIL-STD resistor color code markings.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



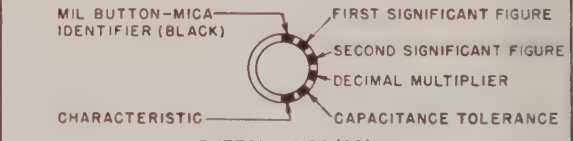
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

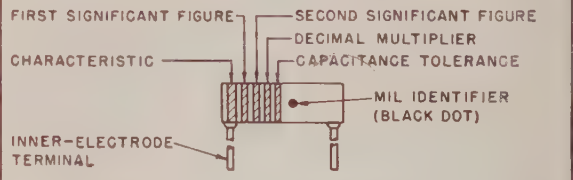


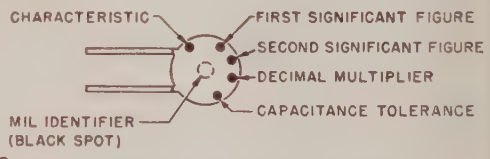
NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



BUTTON-MICA (CB)





NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 21. MIL-STD capacitor color code markings.

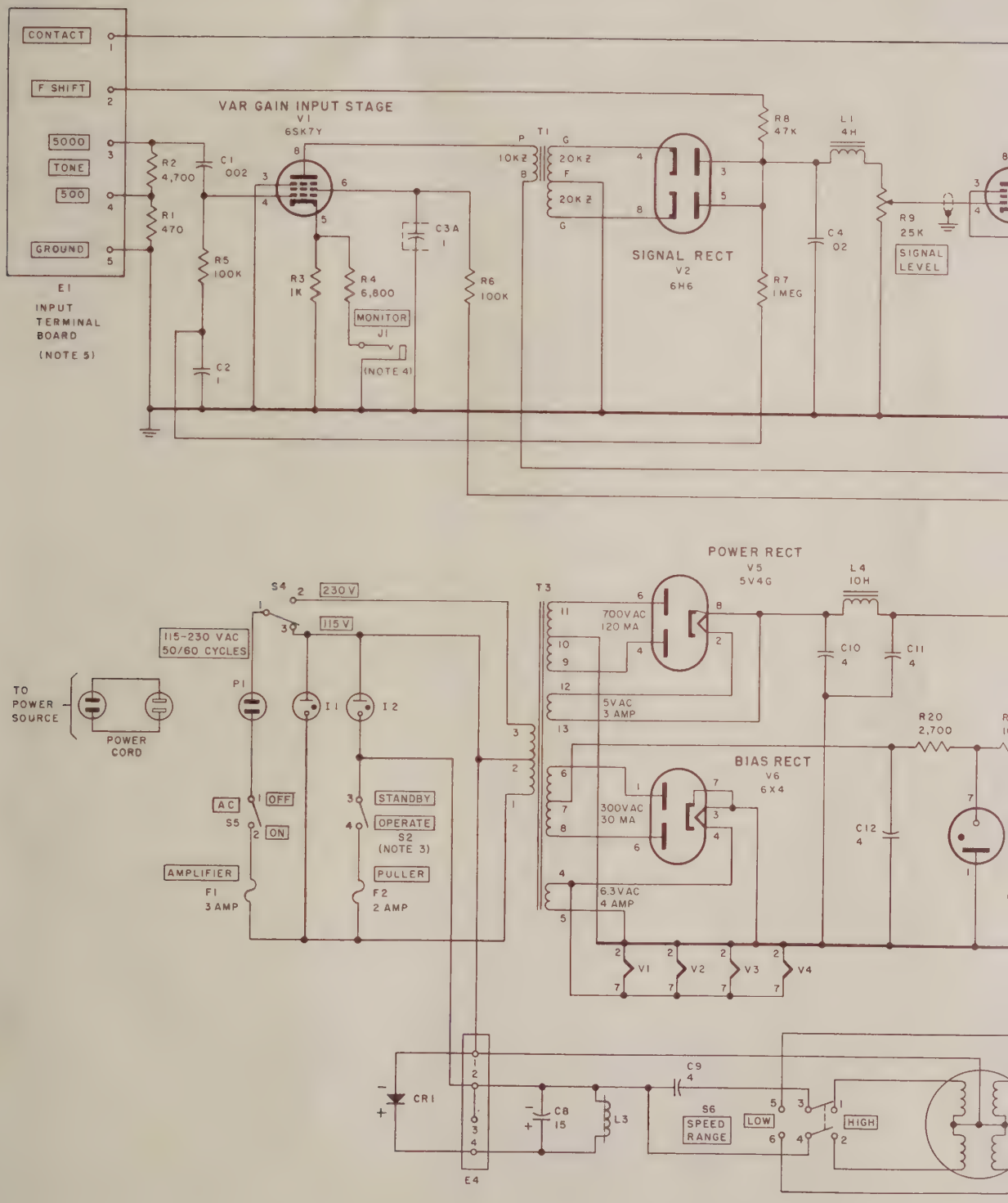
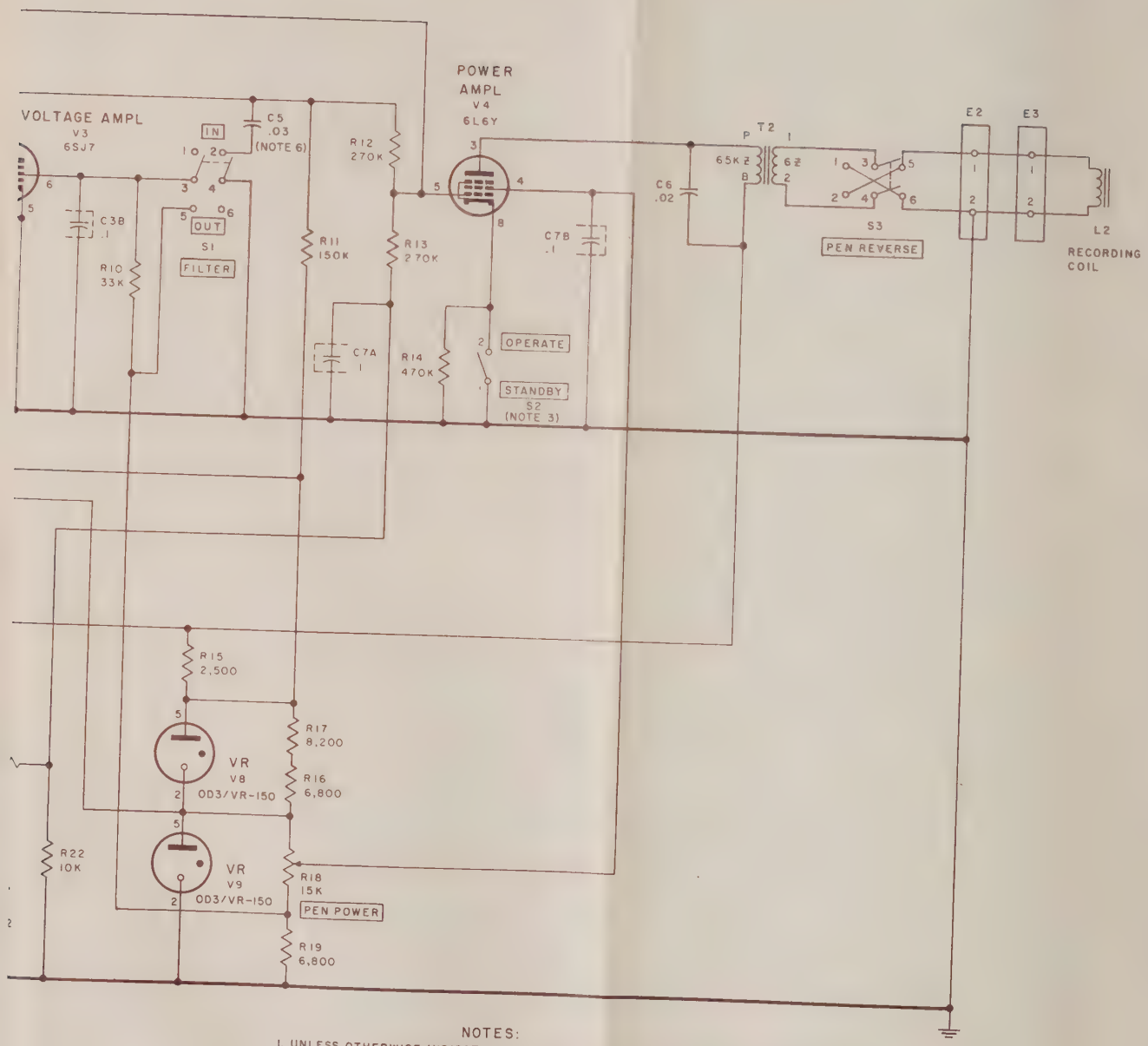


Figure 22. Code Recorder



NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UF.
2. [ ] INDICATES EQUIPMENT MARKING.
3. OPERATE-STANDBY SWITCH S2 IS SHOWN IN TWO PARTS.
4. MONITOR JACK J2 CONNECTS TO HEADPHONES.
5. TERMINAL CONNECTIONS FOR INPUT TERMINAL BOARD E1.

TERMINAL	CONNECTION FOR
1	DIRECT KEYING (TELEGRAPH KEY)
2	FREQUENCY SHIFT SIGNALS
3	HIGH IMPEDANCE INPUT
4	SPEAKER VOICE COIL
5	GROUND SIDE OF INPUT LINE

6. CAPACITOR C5 IS .02 UF ON EQUIPMENTS FURNISHED ON ORDERS NO. 29871-PHILA-55 AND 21597-PHILA-56.
7. THE TUBES IN THE CHART BELOW ARE SUPPLIED WITH EQUIPMENTS ON ORDERS NO. 29871-PHILA-55 AND 21597-PHILA-56.

REFERENCE DESIGNATION	TUBE
V1	6SK7GTY
V2	6H6WGT
V3	6SJ7Y
V4	6L6WGB
V6	6X4W

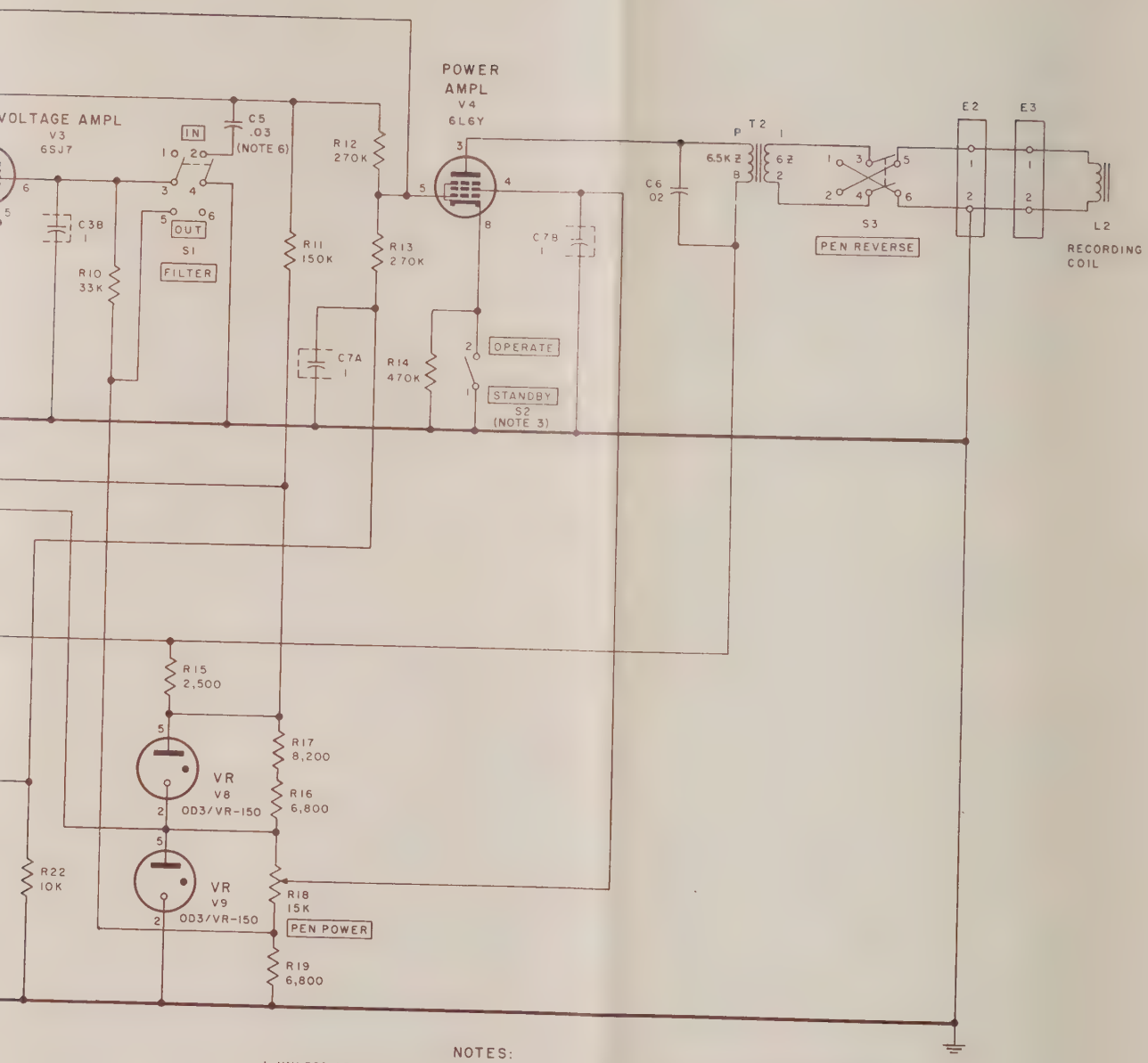
TM5533-22

D-60/U, schematic diagram.

ELL D. TAYLOR,
United States Army,
Chief of Staff.

S D. WHITE,
ed States Air Force.

PRINTING OFFICE: 1957—400812



NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UF.
2. [ ] INDICATES EQUIPMENT MARKING.
3. [OPERATE-STANDBY] SWITCH S2 IS SHOWN IN TWO PARTS.
4. [MONITOR] JACK J2 CONNECTS TO HEADPHONES.
5. TERMINAL CONNECTIONS FOR INPUT TERMINAL BOARD E1.

TERMINAL	CONNECTION FOR
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2	FREQUENCY SHIFT SIGNALS
3	HIGH IMPEDANCE INPUT
4	SPEAKER VOICE COIL
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6. CAPACITOR C5 IS .02 UF ON EQUIPMENTS FURNISHED ON ORDERS NO. 29871-PHILA-55 AND 21597-PHILA-56.
7. THE TUBES IN THE CHART BELOW ARE SUPPLIED WITH EQUIPMENTS ON ORDERS NO. 29871-PHILA-55 AND 21597-PHILA-56.

REFERENCE DESIGNATION	TUBE
V1	6SK7GTY
V2	6H6WGT
V3	6SJ7Y
V4	6L6WGB
V6	6X4W

TM5533-22

-60/U, schematic diagram.

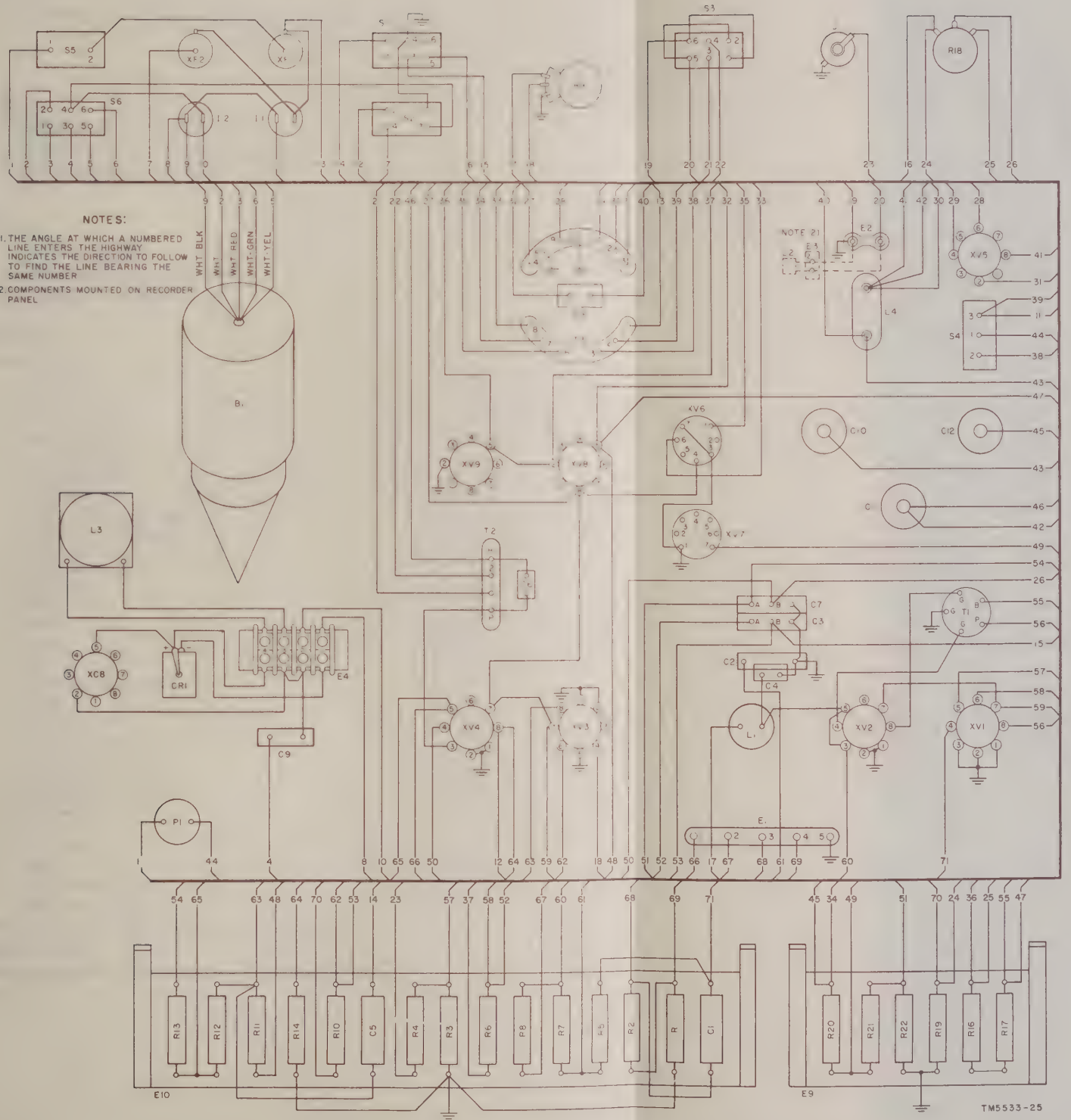

Figure 23. Code Recorder RD–60/U, wiring diagram.

[AG 413.44 (30 April 57)]

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

OFFICIAL:

HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

THOMAS D. WHITE,
Chief of Staff, United States Air Force.

OFFICIAL:

J. L. TARR,
Colonel, United States Air Force,
Air Adjutant General.

Distribution:

Active Army:

CNGB
ASA
Tec Svc, DA
Tec Svc Bd
Arctic Test Bd
Hq CONARC
CONARC Bd
CONARC Bd Test Sec
Army Air Def Comd
OS Maj Comd
OS Base Comd
Log Comd
MDW
Armies
Corps
Div
US Army Tng Cen
Ft & Cp
Sp Wpn Comd
Sp War Cen
Gen & Br Svc Sch
Gen Depots
Sig Sec, Gen Depots
Sig Depots
AMS
WRAMC
AFIP
Army Pictorial Cen
Engr Maint Cen
Army Comm Agency
Army Sig Comm Engr Agency
Army Sig Pub Agency
White Sands Sig Agency
Yuma Test Sta
POE (OS)
Trans Terminal Comd
Army Terminals
OS Sup Agencies
Army Elct PG
Sig Fld Maint Shops
Sig Lab
Mil Dist
JBUSMC
Units org under fol TOE:
11–7
11–16
11–57
11–127
11–128
11–500
11–557
11–587
11–592
11–597
32–51
32–55
32–56
32–500

NG: State AG; units—same as Active Army.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

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